CS300™

Service Manual

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Foreword

This manual is intended to provide information required to properly service the Datascope **CS300** Intra-Aortic Balloon Pump.

Warnings, Precautions and Notes

Please read and adhere to the following list of warnings, precautions and notes; some of which are repeated in the appropriate areas throughout this manual.

A **WARNING** is provided if there is reasonable evidence of an association of a serious hazard with the misuse of this device or when special attention is required for the safety of the patient.

A **PRECAUTION** is provided when any special care is to be exercised by the practitioner to avoid causing damage to this device or other property. They may also include actions to be taken to avoid effects on patients or users that may not be potentially life threatening or result in serious injury, but about which the user should be aware.

A **NOTE** is provided when extra general information is applicable. Notes appear in the appropriate areas throughout the manual.

Warning

WARNING: Compressed gasses (helium cylinders) are considered Dangerous Goods/Hazardous Materials per I.A.T.A. and D.O.T. Regulations.

It is a violation of federal and international law to offer any package or over pack of dangerous goods for transportation without the package being appropriately identified, packed, marked, classified, labeled and documented according to D.O.T. and I.A.T.A. regulations. Please refer to the applicable I.A.T.A. Dangerous Goods Regulations and / or the Code of Federal Regulations 49 (Transportation, Parts 171-180) for further information.

WARNING: Preventive Maintenance should not be performed when the IABP is attached to a patient.

Precautions

CAUTION: Do not short component leads together.

CAUTION: The troubleshooting charts are not intended as a rapid course on how to repair devices of this type. Rather, they are intended as a guide for qualified technical personnel only. The instrument covers should only be removed by technically qualified personnel who have received supplementary instructions regarding maintenance of medical electronic equipment or have had equivalent experience in this area.

CAUTION: **The accidental shorting of component leads can easily over stress components, resulting in a second unnecessary failure (aside from creating a possible safety risk).**

CAUTION: **To avoid damage, do not use the high powered iron to repair printed wiring boards as the conductors will lift from the surface under the extreme heat.**

Notes

NOTE: **Datascope maintains a policy of continual product improvement and reserves the right to change materials and specifications without notice.**

1.0 *Theory of Operation*

The Theory of Operation is divided into two parts. The first part contains block diagrams for the entire system, including cabling, and pneumatics. It should be used by service personnel to become familiar with the internal organization of the instrument. The second part contains PCB drawings, the related block diagrams, and a brief circuit description.

1.1 System Block Diagrams

The Block Diagrams indicate the internal organization of the instrument. They are used to gain familiarity with the instrument and to locate malfunctioning PC boards as readily as possible. To avoid clutter, the number of PC board interconnects is minimized. The interconnects shown represent major or essential signal flow and clock connections.

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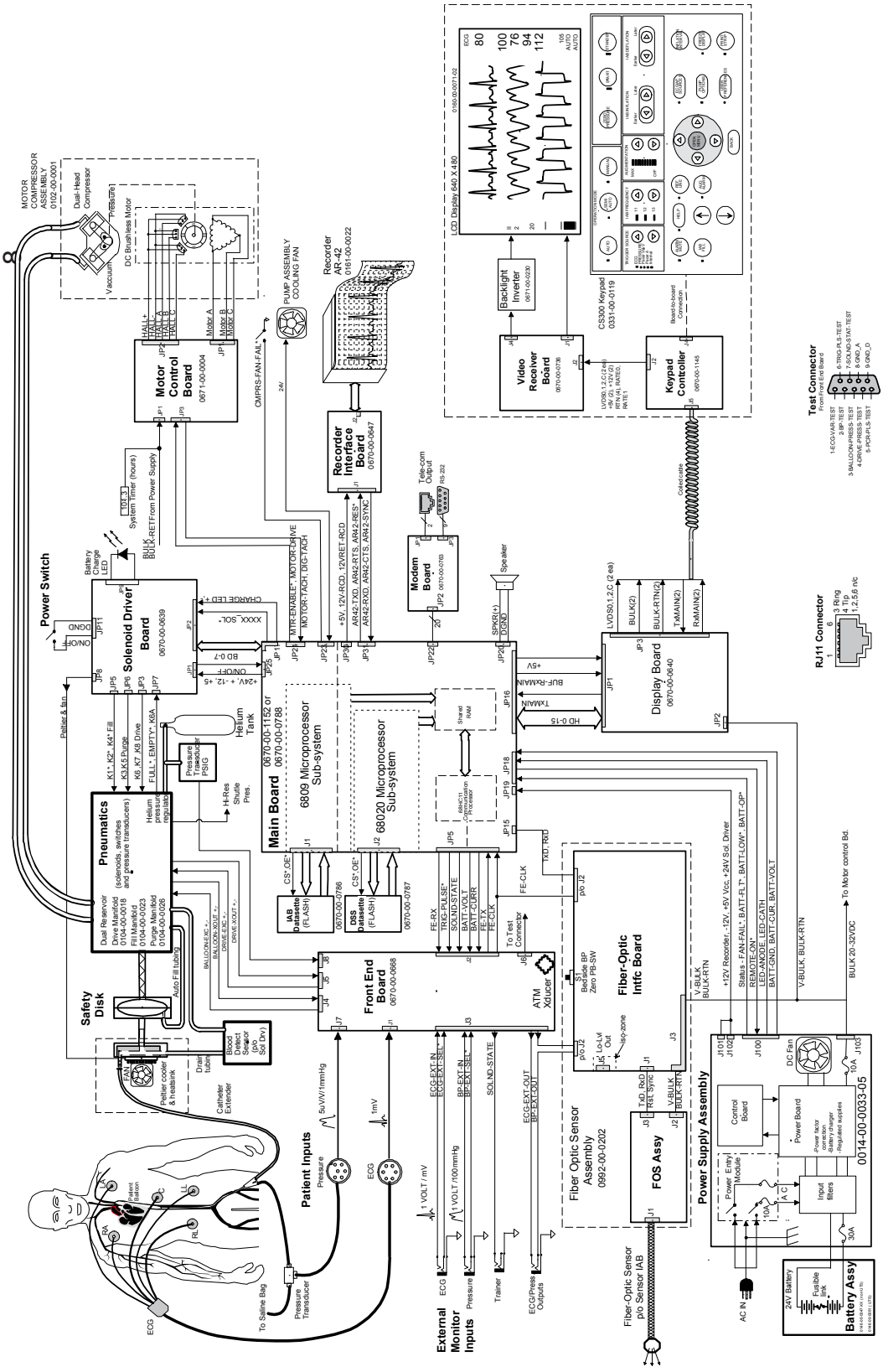

FIGURE 1-1 System Block Diagram

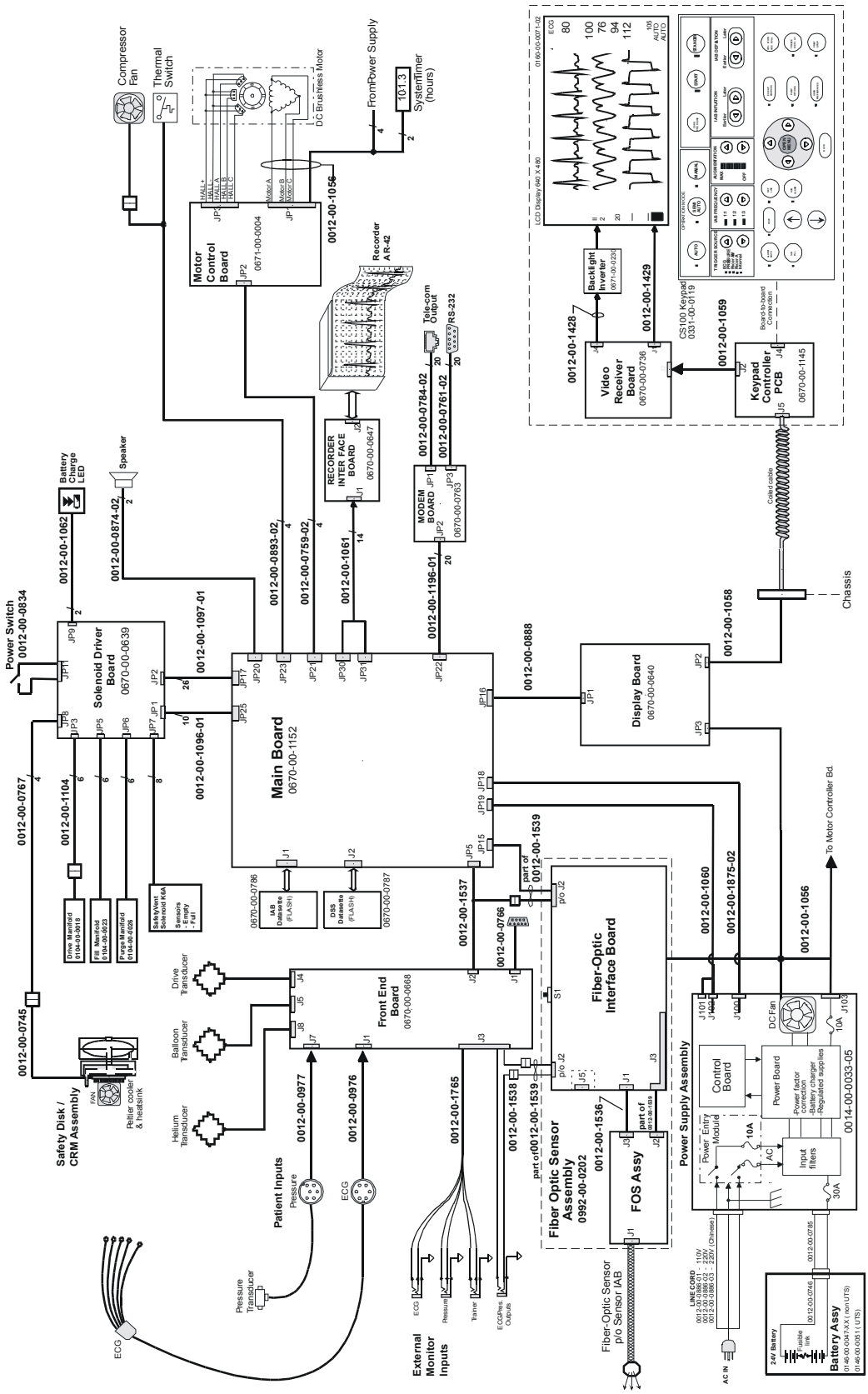

FIGURE 1-2 Cable Block Diagram

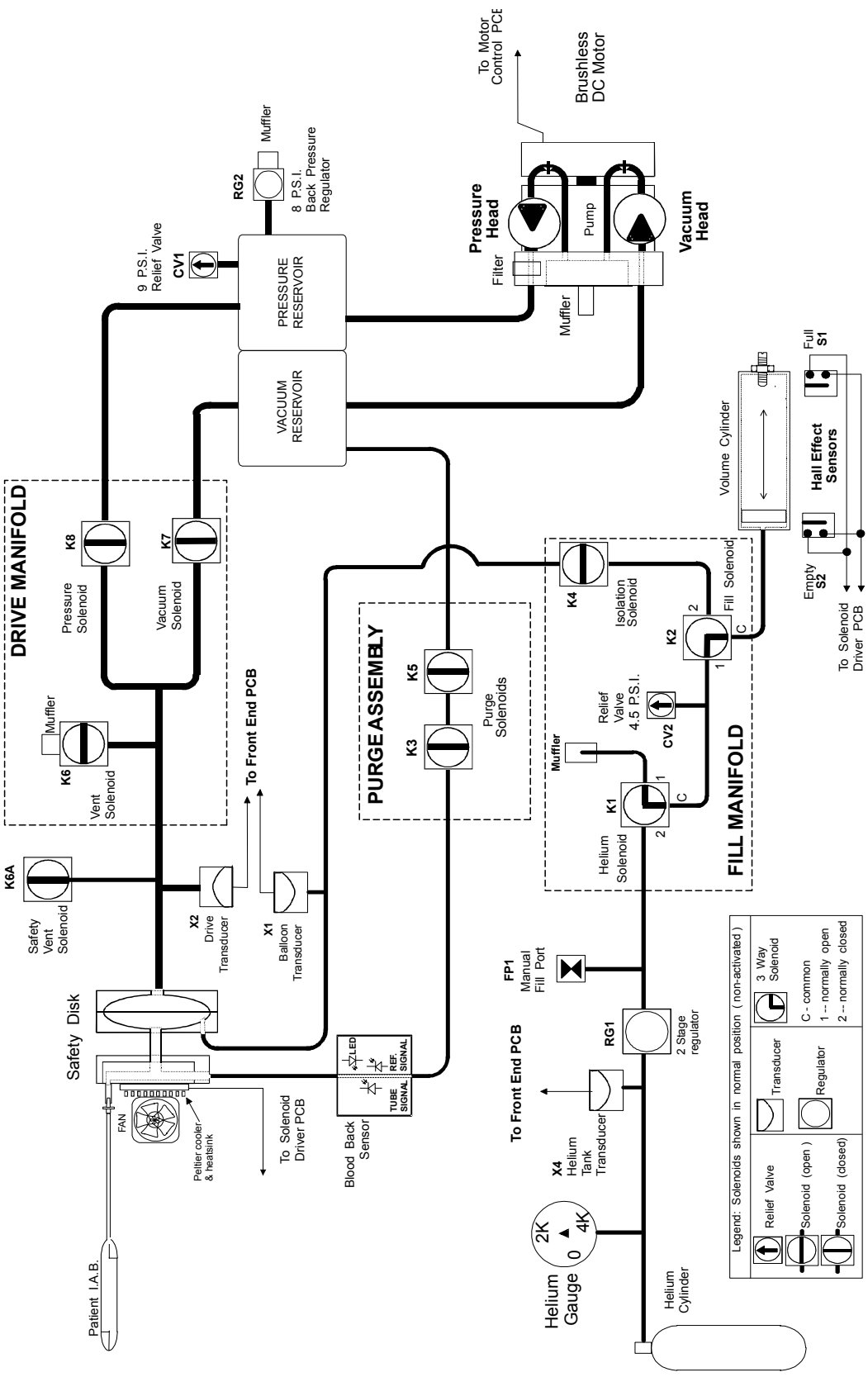

FIGURE 1-3 Pneumatic Block Diagram

1.2 Circuit Descriptions

1.2.1 Power Supply for CS300

P/N	INPUTS	OUTPUTS
0014-00-0033-05	AC Mains, Battery	18 - 32 volts (main or bulk supply) 24 V (solenoid supply) +/-12 volts, +5 volts, Battery charger, charge LED drive

1.2.2 Sensor Module

P/N	DESCRIPTION
0992-00-0202	The Fiber Optic Sensor Assembly accepts an optical signal that communicates blood pressure information from a sensor placed in the intra-aortic balloon.

Circuit Descriptions Page

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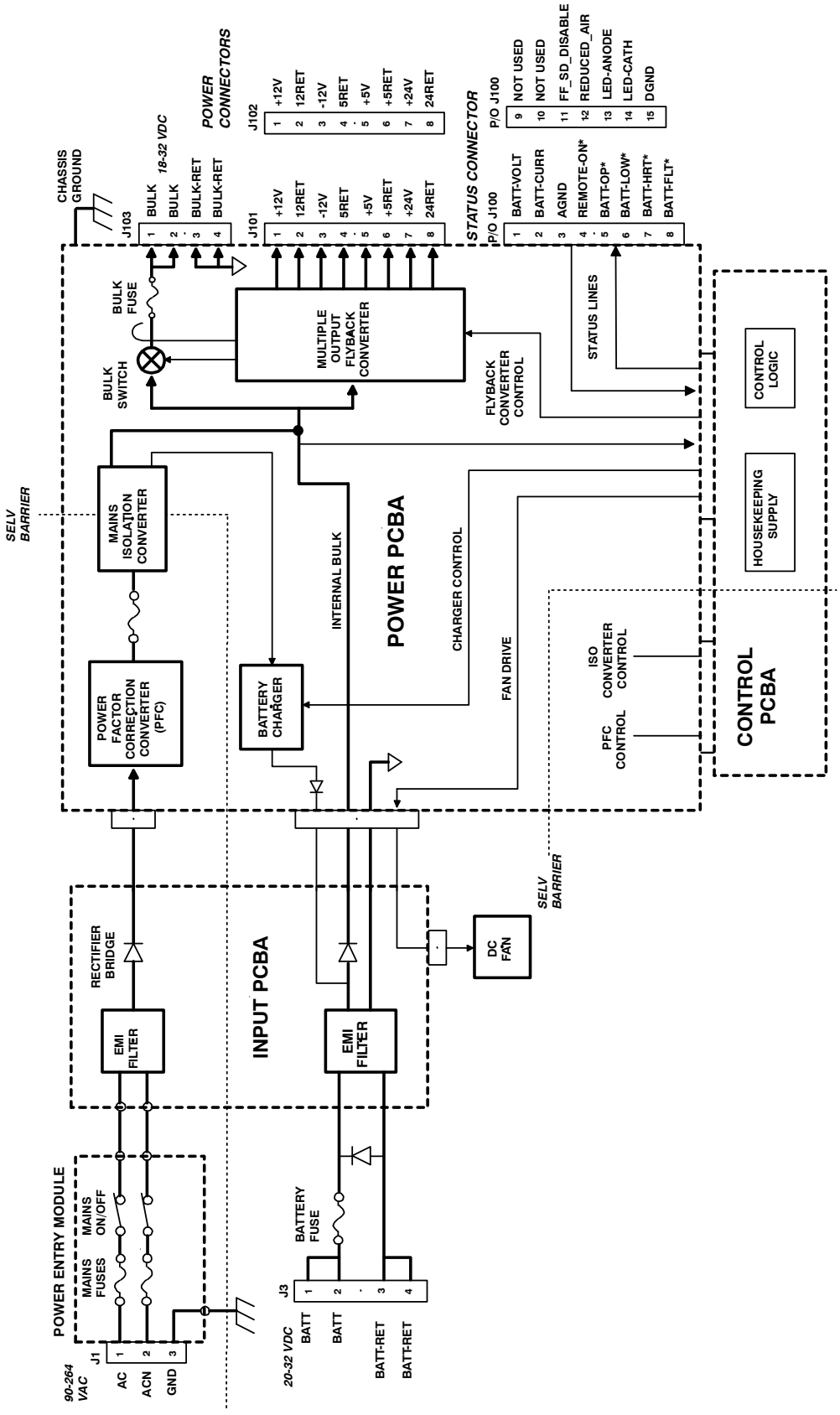


FIGURE 1-4 Power Supply Assembly Block Diagram P/N 0014-00-0033-05

Front End Description

ECG

- Patient isolation
- ESU filters
- Lead selection
- Reference lead drive
- External ECG signal selection
- Pacer detection
- ECG trigger signal conditioning
- ECG size
- ECG ESD protection
- ECG defibrillator protection

Pressure

- Patient isolation
- Pressure scaling
- Auto zero circuit
- Pressure gain adjustment
- External pressure signal selection
- Pressure ESD protection

Data Acquisition

- Pneumatic transducer amplifiers
- A/D converter for display signals
- 12-Bit A/D converter
- Transducer excitation voltages

Microcontroller

- Serial interface to Main Board
- ECG circuit control latches
- Pressure circuit control latches
- Controls A/D conversion
- Pacer blanking
- ESU detect and time-out
- Auto zero control

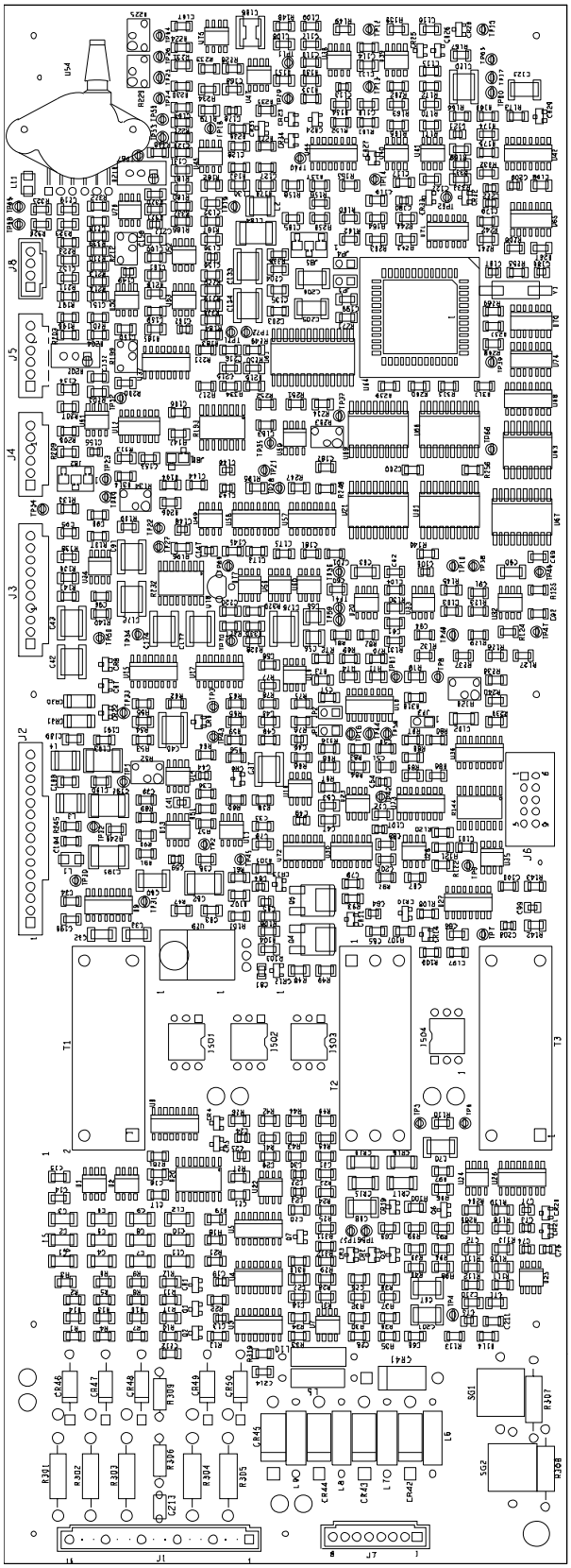


FIGURE 1-5 Front End PCB Drawing
P/N 0670-00-0668

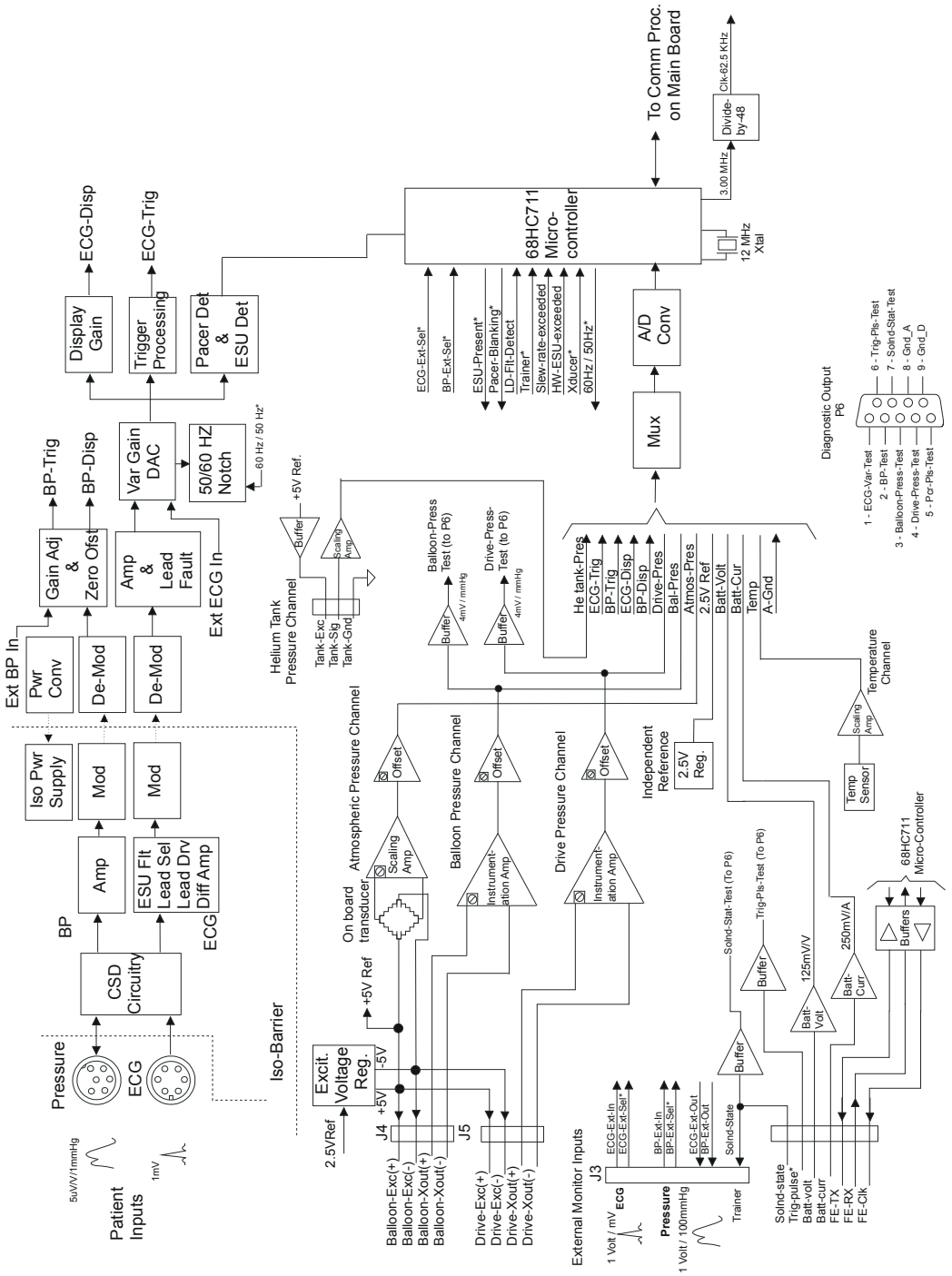


FIGURE 1-6 Front End PCB Block Diagram
P/N 0670-00-0668

Main Board Description

6809 Microprocessor (2 MHz)

- 50 k EPROM (Datasette)
- 12 k RAM
- Solenoid control signals
- Watchdog timer
- Alarm processing
- Pneumatic switch status
- IABP control status
- Motor speed D/A converter

68020 Microprocessor (33 MHz)

- 2 M EPROM (Datasette)
- 2 M RAM
- Real time clock and NVRAM
- Display interface
- Recorder control
- Recorder interface
- RS-232 interface
- Modem interface
- Configuration DIP switch

68HC711 Microprocessor

Serial interface to the Front End, Solenoid Driver and Keypad Controller boards

- Shared RAM interface

Shared RAM

- Port 1 interfaces with the 68020 sub-system
- Port 2 interfaces with the 6809 sub-system
- Port 3 interfaces with the 68HC711 (communications processor)

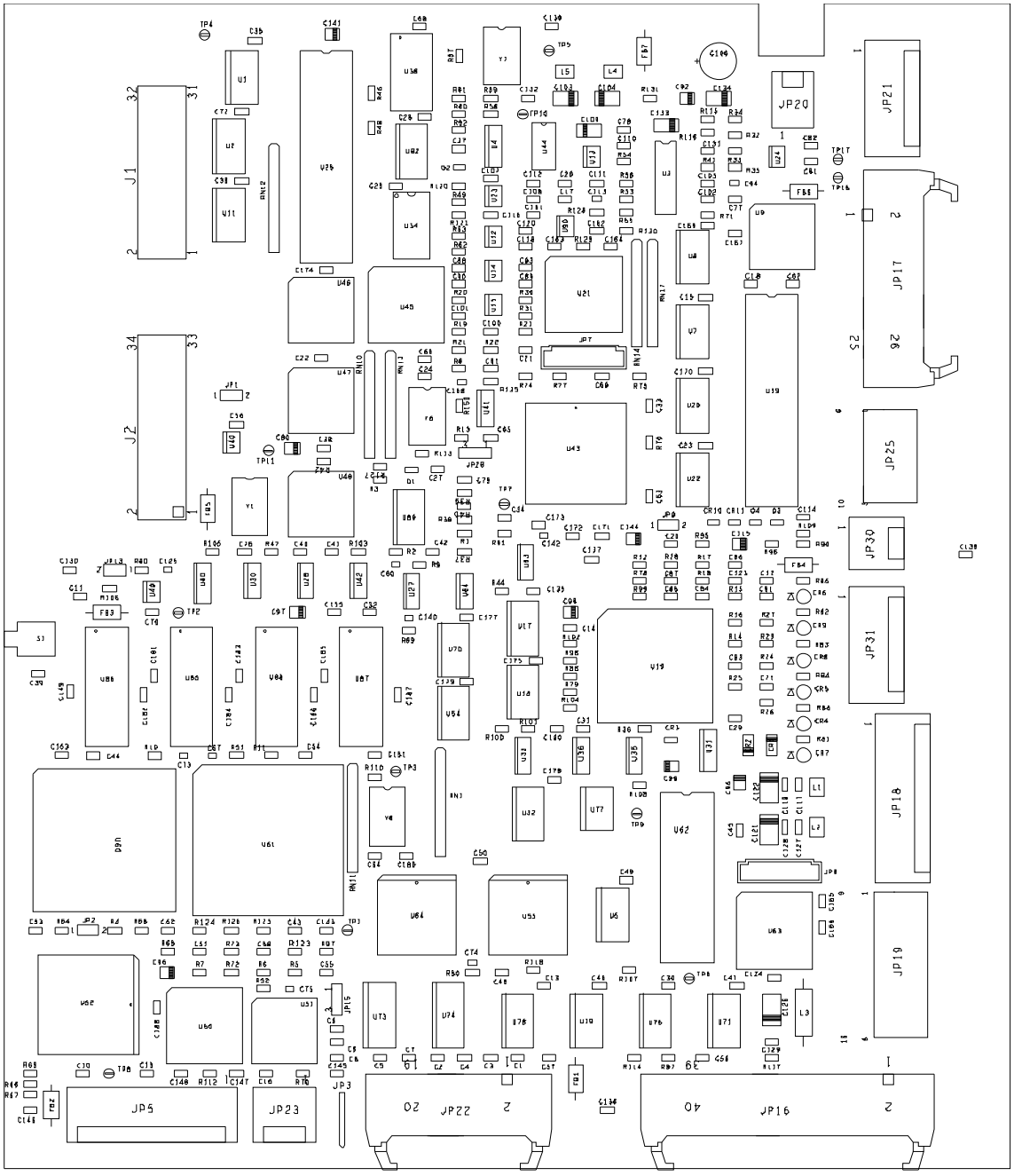


FIGURE 1-7 Main PCB Drawing
P/N 0670-00-1152

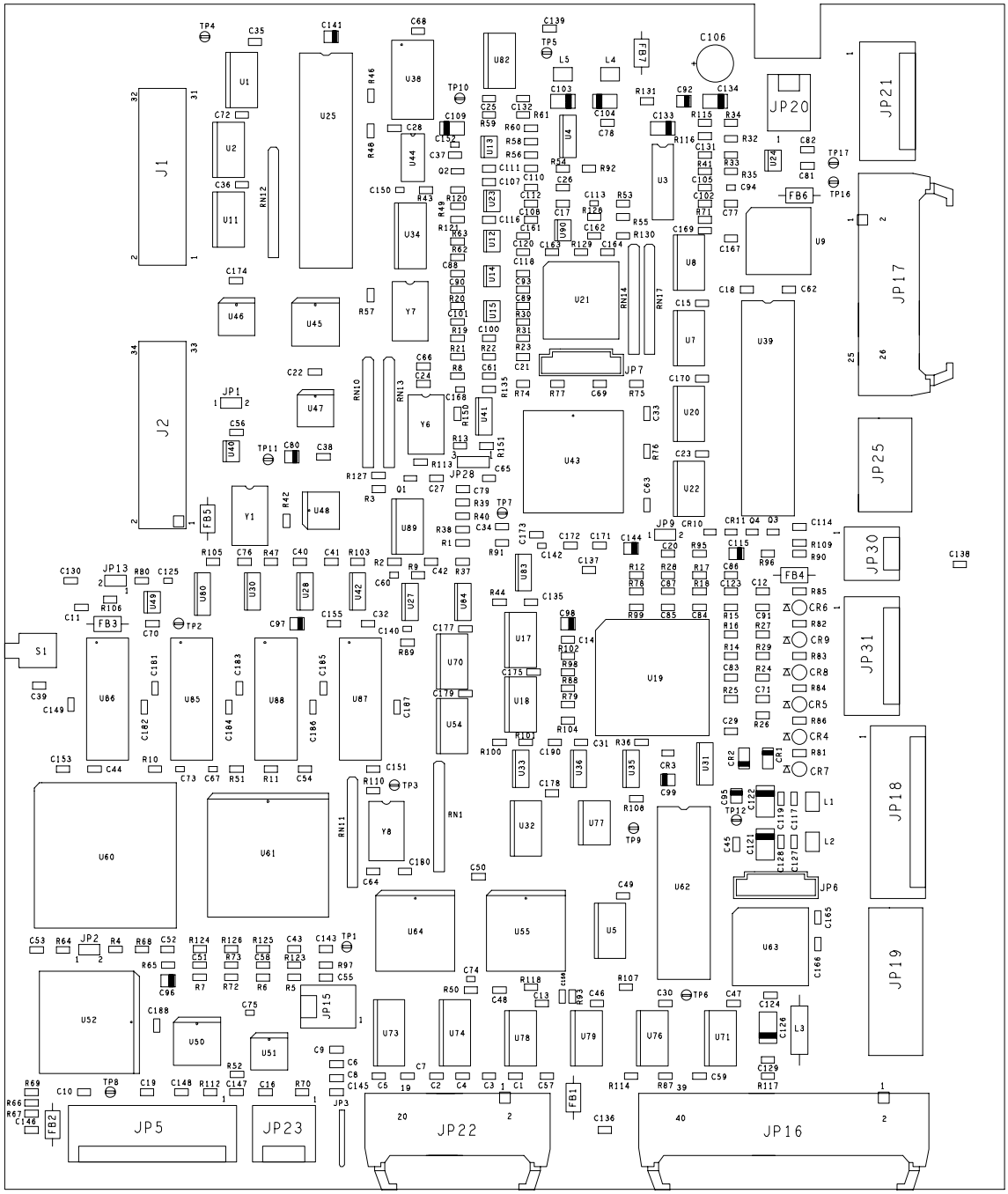


FIGURE 1-8 Main PCB Drawing
P/N 0670-00-0788

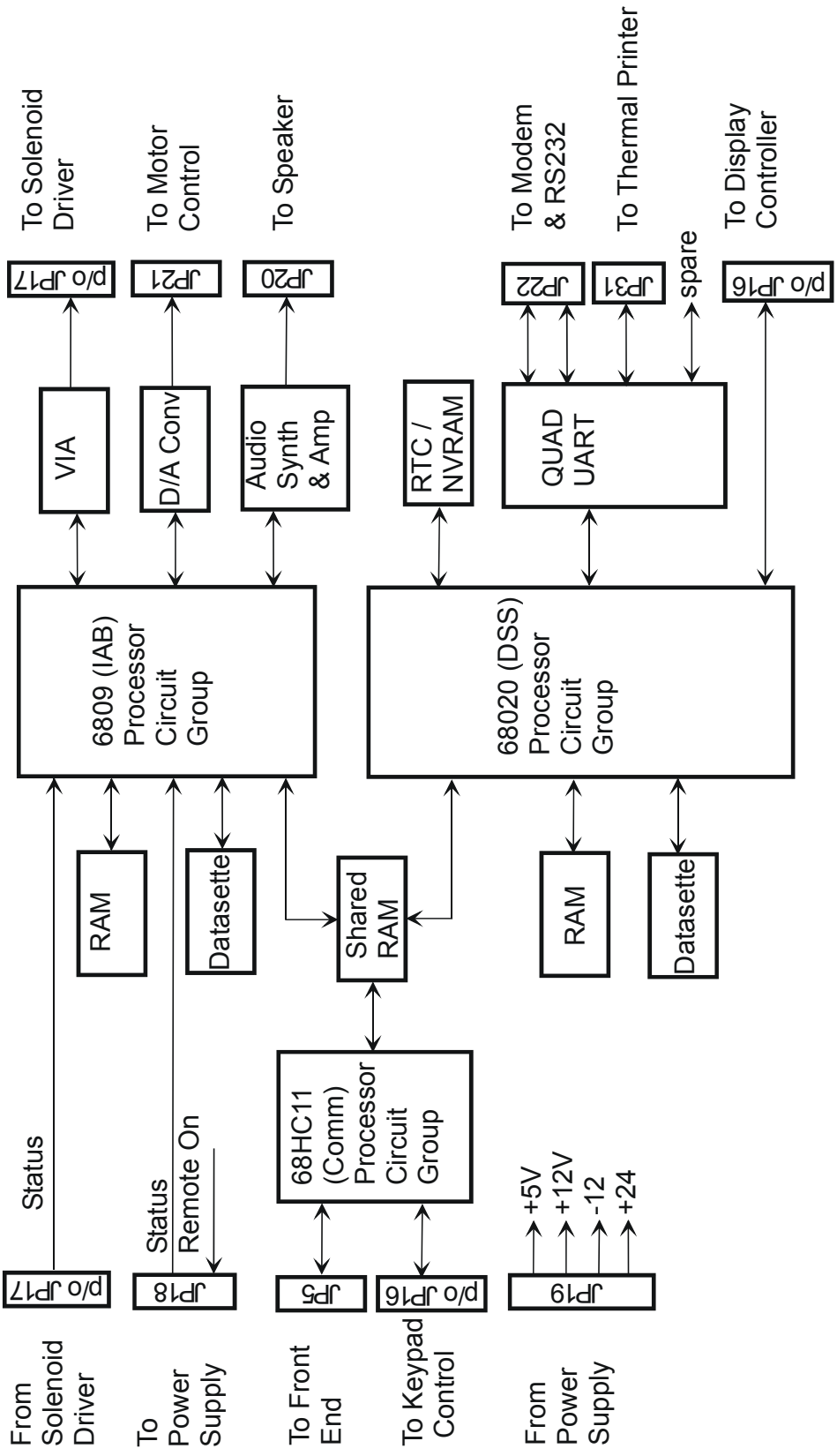


FIGURE 1-9 Main Board Block Diagram
P/N 0670-00-1152 / 0670-00-0788

Display Controller Description

- Generates system display via Hitachi ACRTC device
- Acts as peripheral to 68020 (DSS) processor
- Transmits video data and control signals to display head via LVDS transmitter
- Provides serial communications link between Comm Proc and Keypad Controller
- Provides V-Bulk supply voltage to Display Head assembly with soft-start circuit

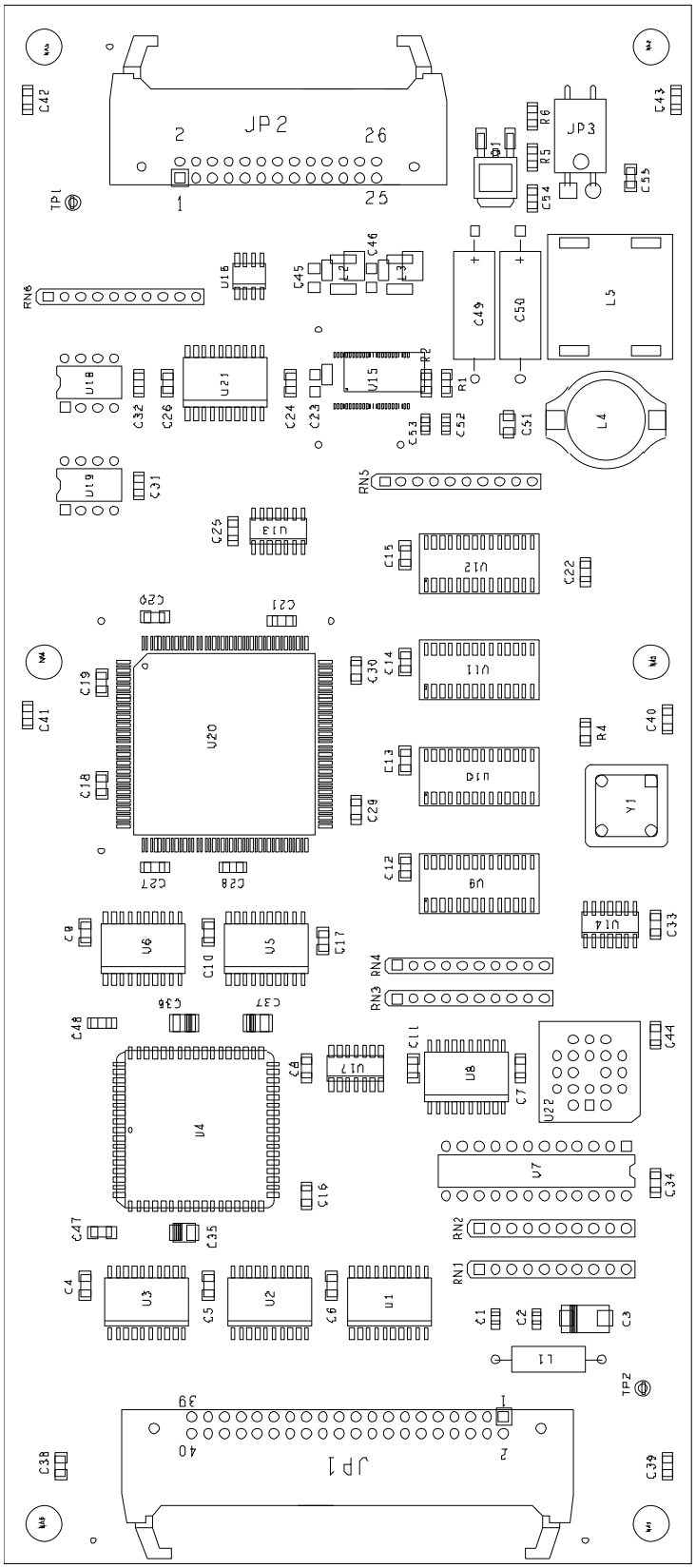


FIGURE 1-10 Display Controller PCB Drawing
P/N 0670-00-0640

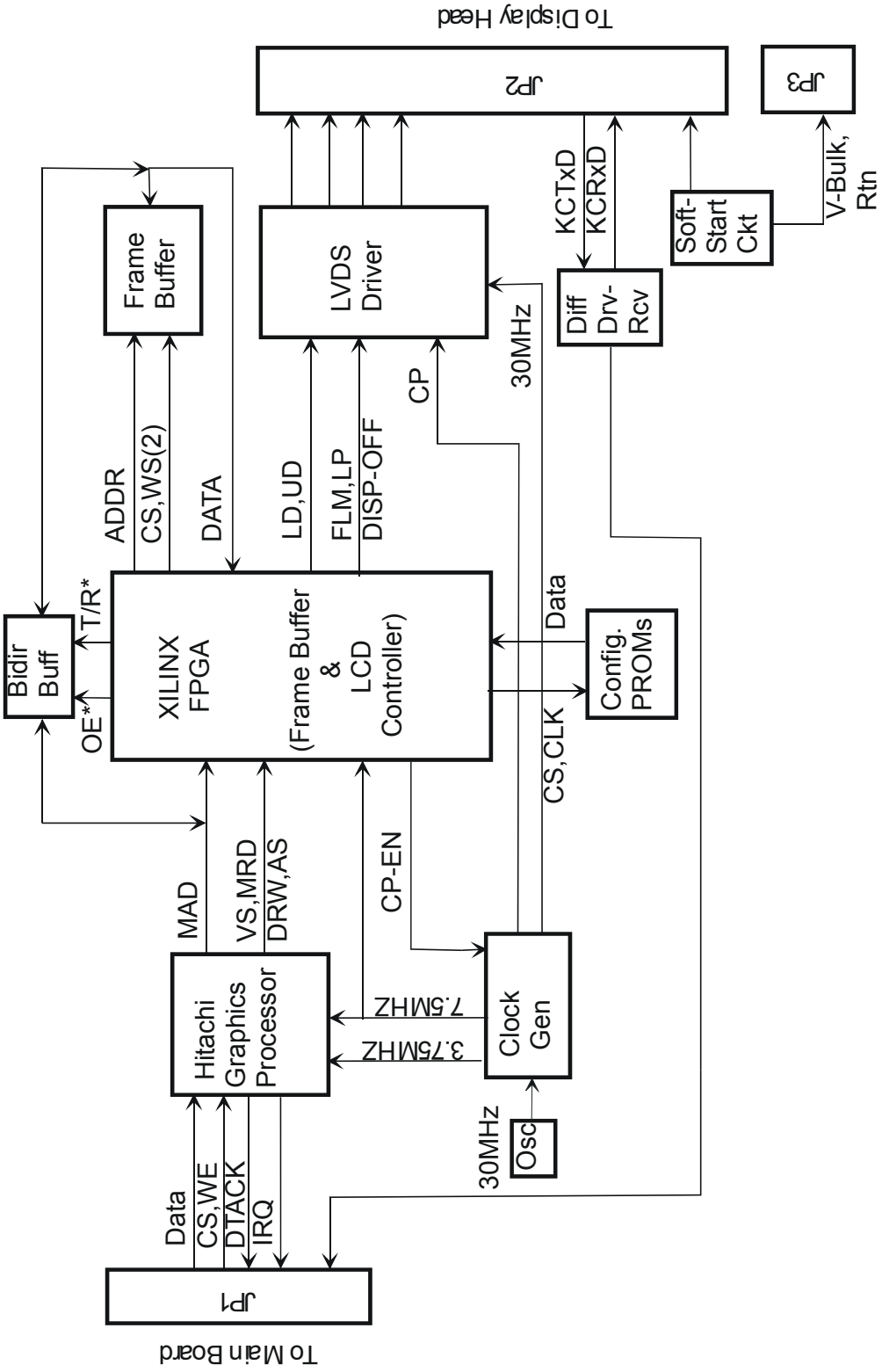


FIGURE 1-11 Display Controller Block Diagram P/N 0670-00-0640

Solenoid Driver Description

- Receives solenoid control signals (11) from Main Board
- Energizes fill solenoids (K1, K2, K3, K4 and K5)
- Energizes drive solenoids (K6, K6A, K7 and K8)
- Provides prolonged inflation watch-dog timer
- De-energizes drive solenoids if watch-dog timer expires and sends signal to Main Board
- Energizes Peltier devices in Safety Disk
- Incorporates blood detection circuitry

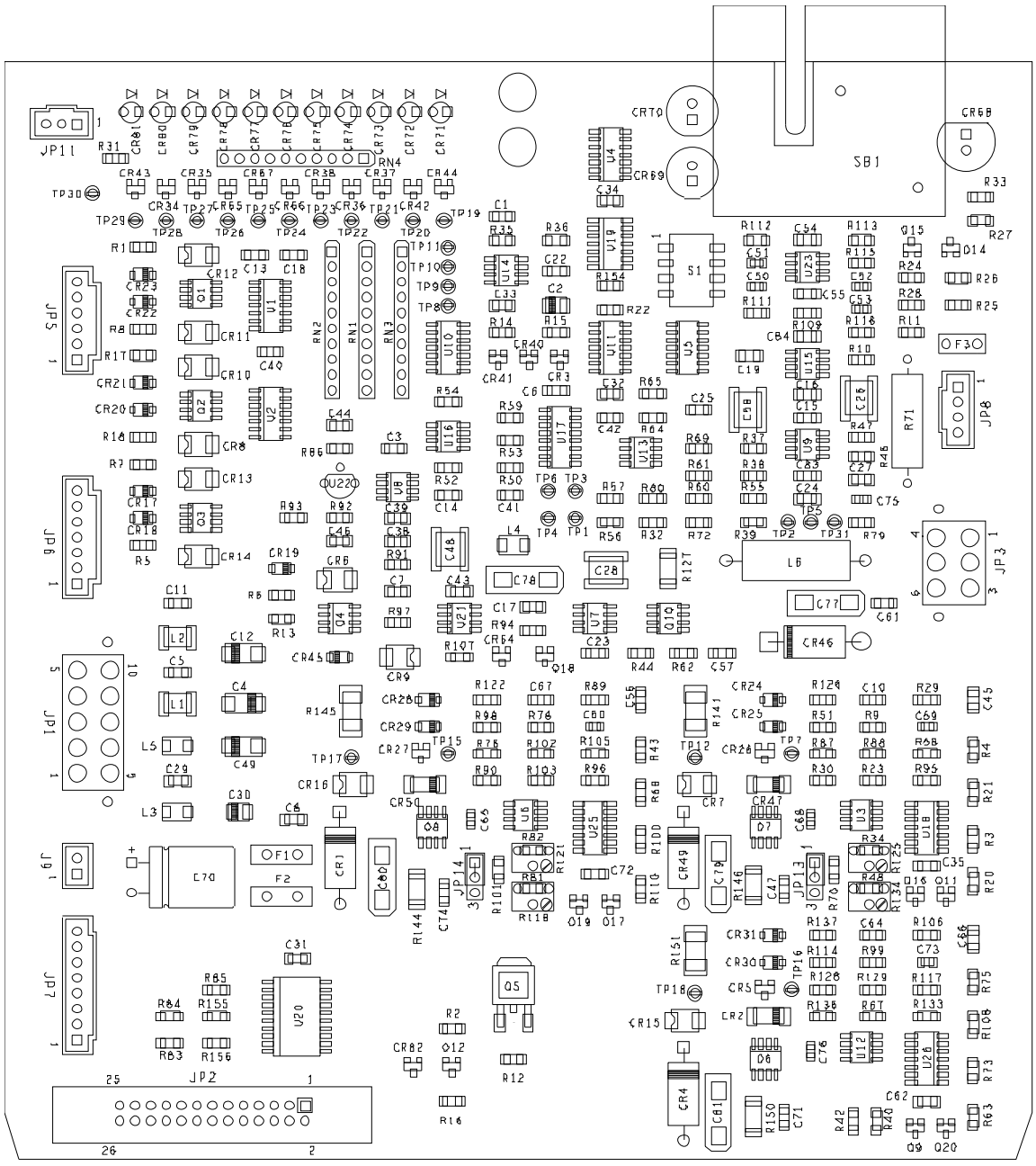


FIGURE 1-12 Solenoid Driver PCB Diagram
P/N 0670-00-0639

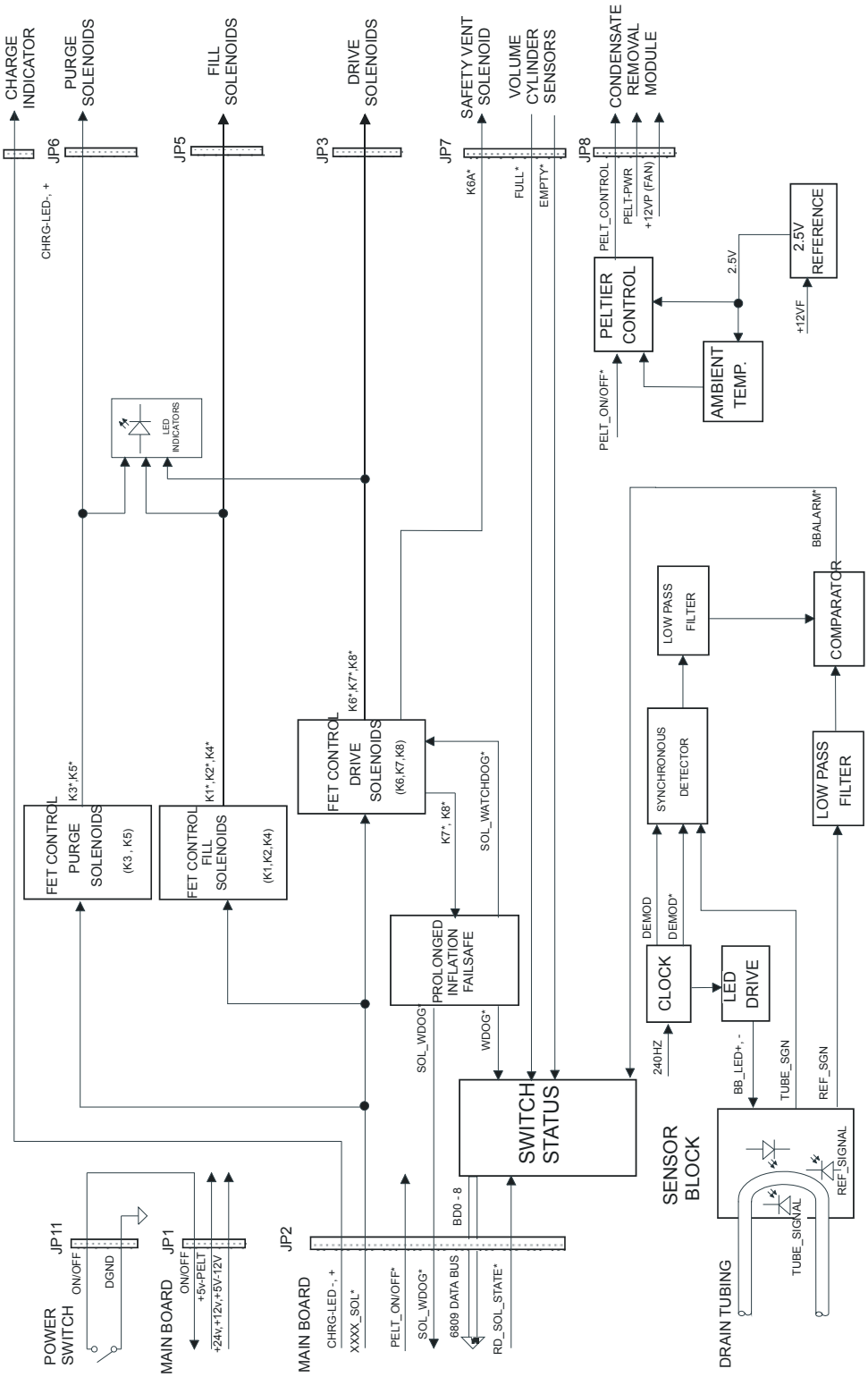


FIGURE 1-13 Solenoid Driver PCB Block Diagram P/N 0670-00-0639

Keypad Controller Description

- 68HC11 micro-controller continually scans key matrix of 7 Rows X 6 Columns (42 keys max)
- Micro-controller controls LEDs via serial input LED driver chip
- Micro-controller communicates switch closures and receives LED data via serial communications link to Comm Processor on Main Board
- Passes video interface (LVDS) through to Video Receiver PCBA
- Provides DC/DC converters from V-Bulk to +5V and +12V to power this PCBA, Video Receiver and LCD display panel

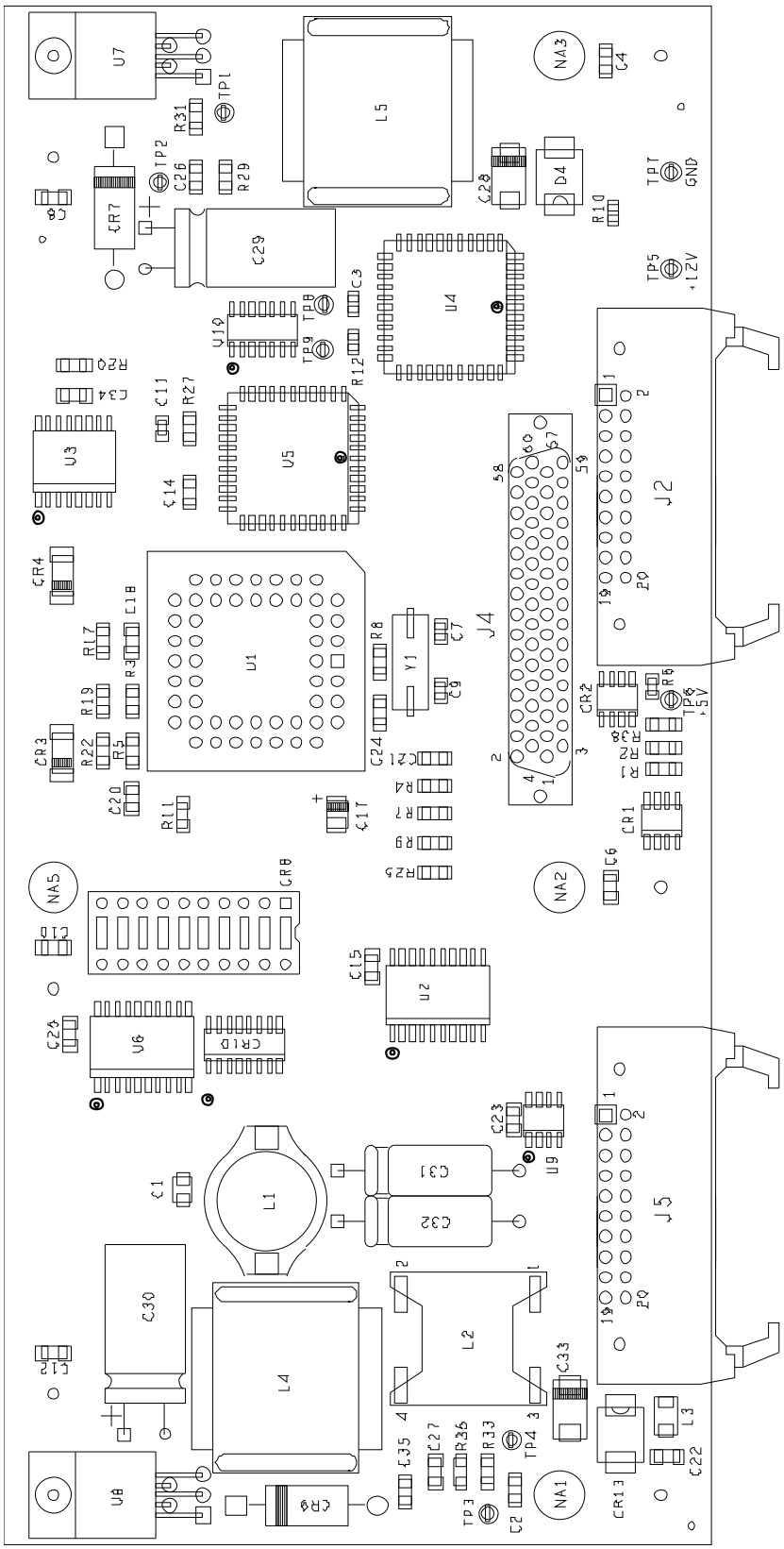


FIGURE 1-14 Keypad Controller PCB Diagram P/N 0670-00-1145

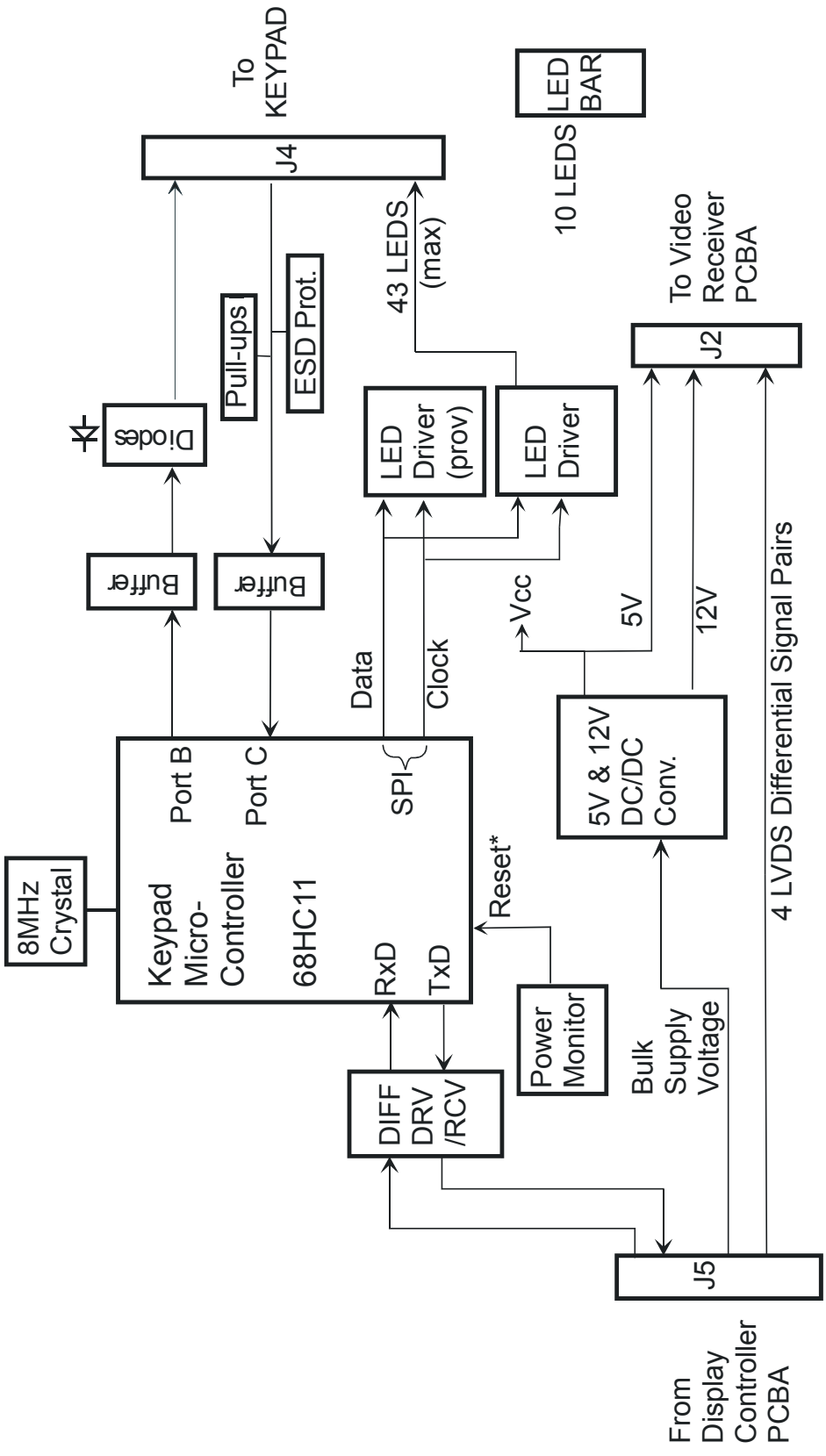


FIGURE 1-15 Keypad Controller Block Diagram P/N 0670-00-1145

Video Receiver Description

- Receives video data and controls from Display Controller via LVDS receiver device
- FPGA device manages local video memory for display refresh
- FPGA provides color translation function
- FPGA controls LCD display panel
- FPGA controls backlight inverter to provide varying display intensity

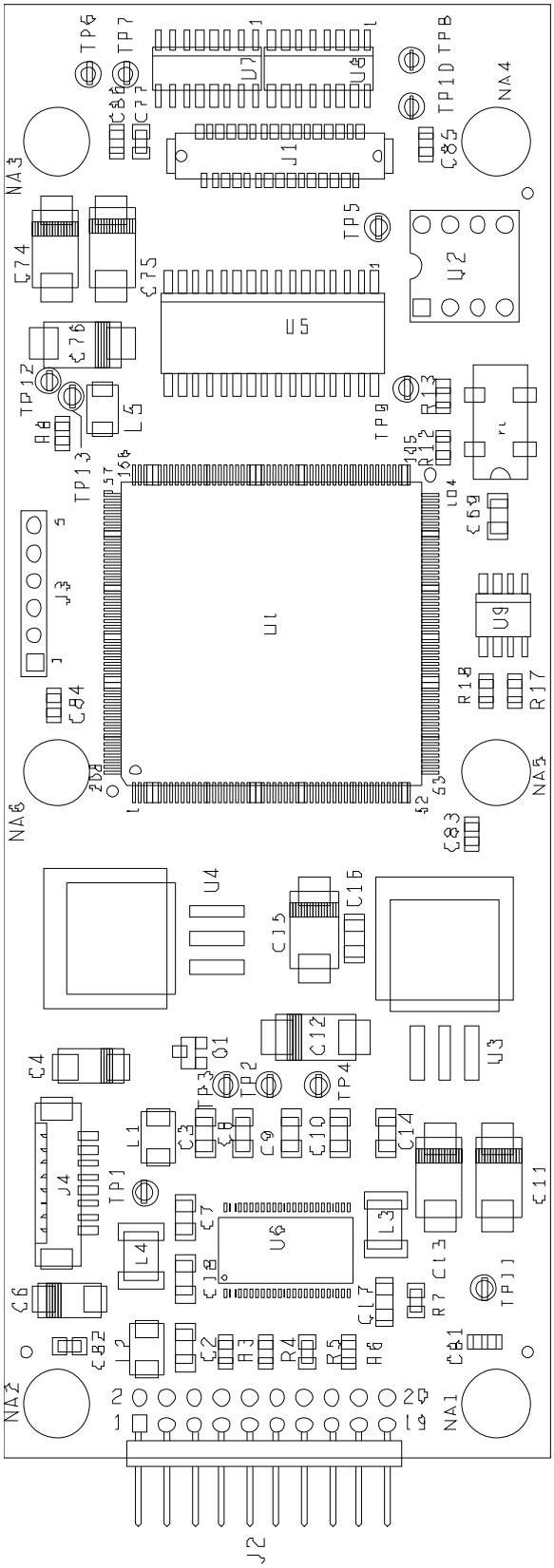


FIGURE 1-16 Video Receiver Board Diagram
P/N 0670-00-0736

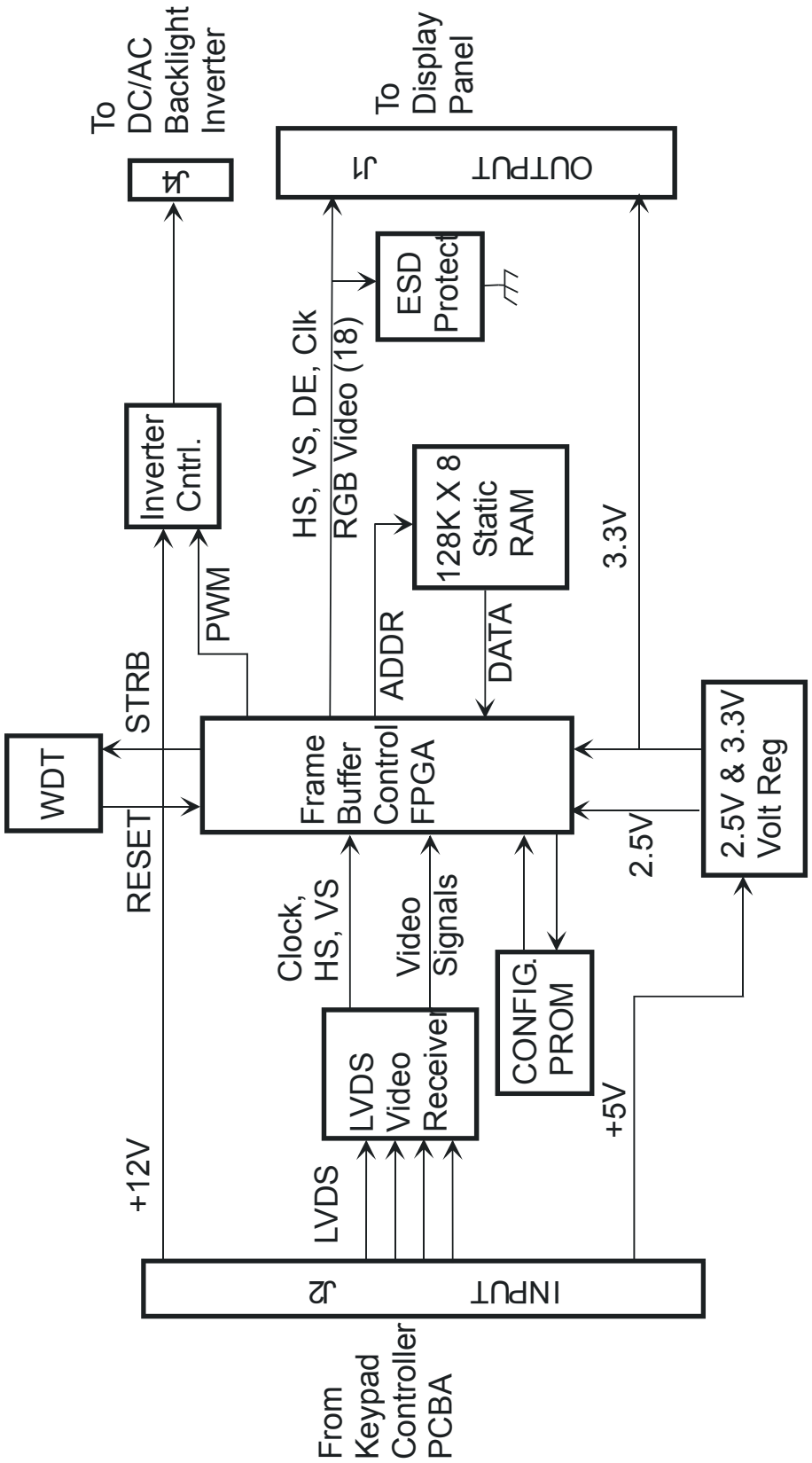


FIGURE 1-17 Video Receiver Block Diagram P/N 0670-00-0736

Sensor Module Description

The Sensor Module Assembly is designed to accept an optical signal which communicates blood pressure information from a sensor placed in an intra-aortic balloon.

The Sensor Module Assembly provides the **CS300** with the following functions:

- Converts optical signal from sensor to pressure signal.
- Provides twin light source for sensor excitation.
- Performs self diagnostics and diagnostics of sensor.
- Provides serial communication link between the Fiber Optic Converter and the Main PCB.
- Performs signal processing of pressure data using a digital signal processor (DSP).
- Provides patient isolated defibrillator proof low level Fiber Optic pressure output for interface to bedside monitor.
- Generates high level pressure output when using a Sensor IAB and provides switching of high level pressure output jack.
- Provides filtering and fusing of V-bulk for its own power and the needs of the Fiber Optic Converter.
- Power Requirements: +10.5 to +32.0V DC
- Power Consumption: 4.0W, max

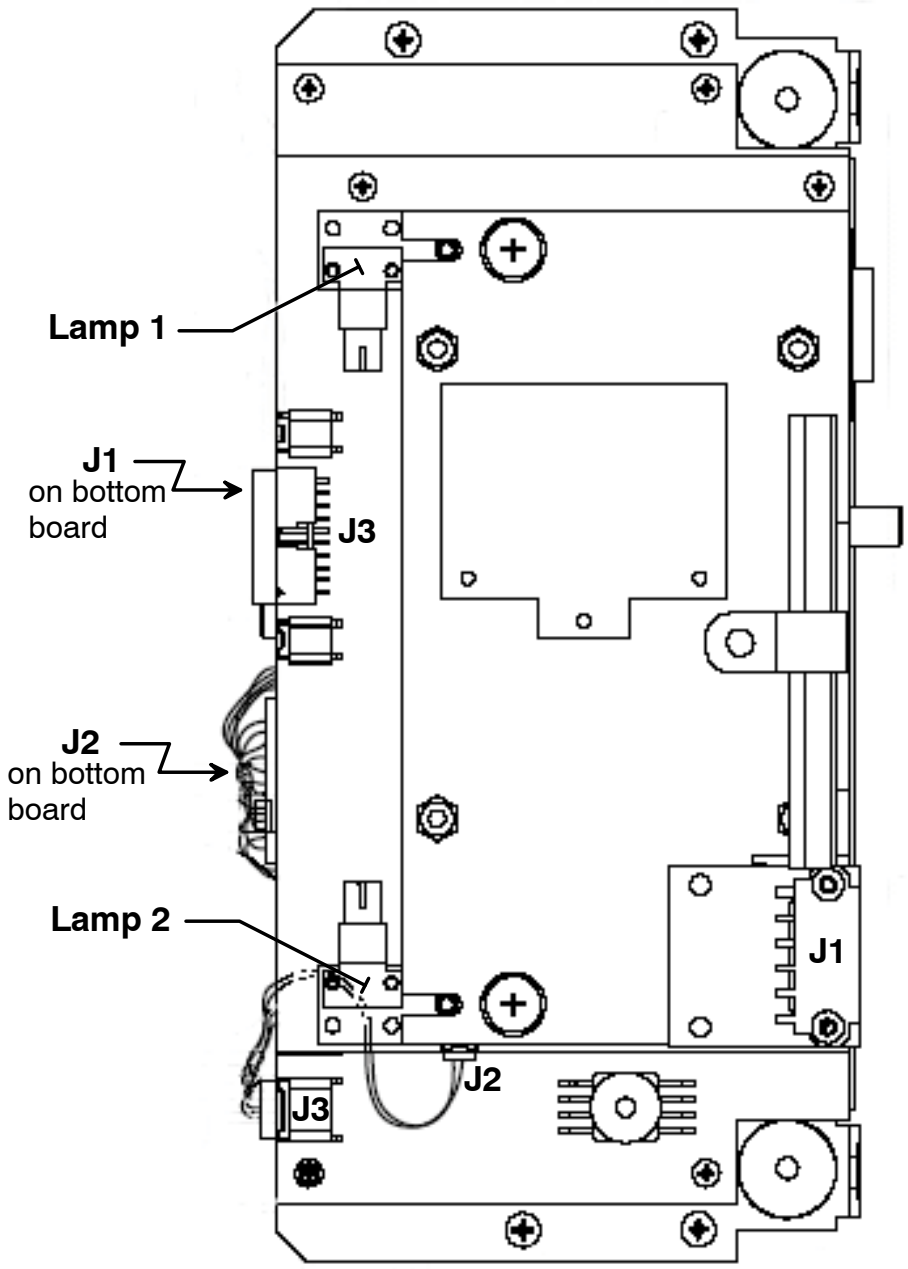
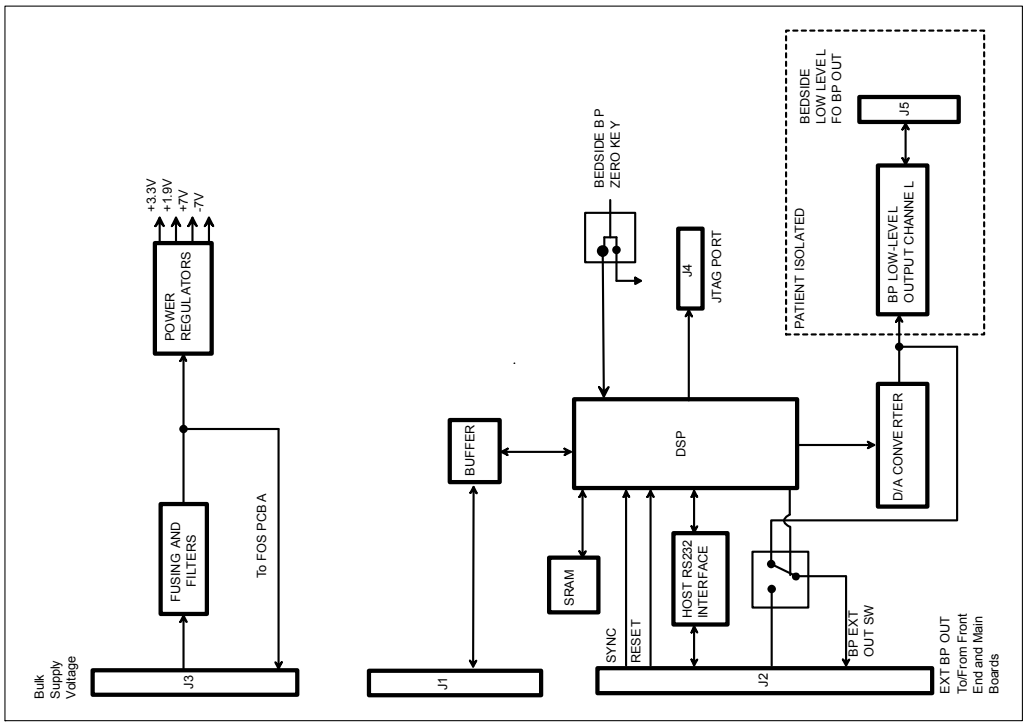


FIGURE 1-18 Sensor Module Board Diagram
P/N 0997-00-1161



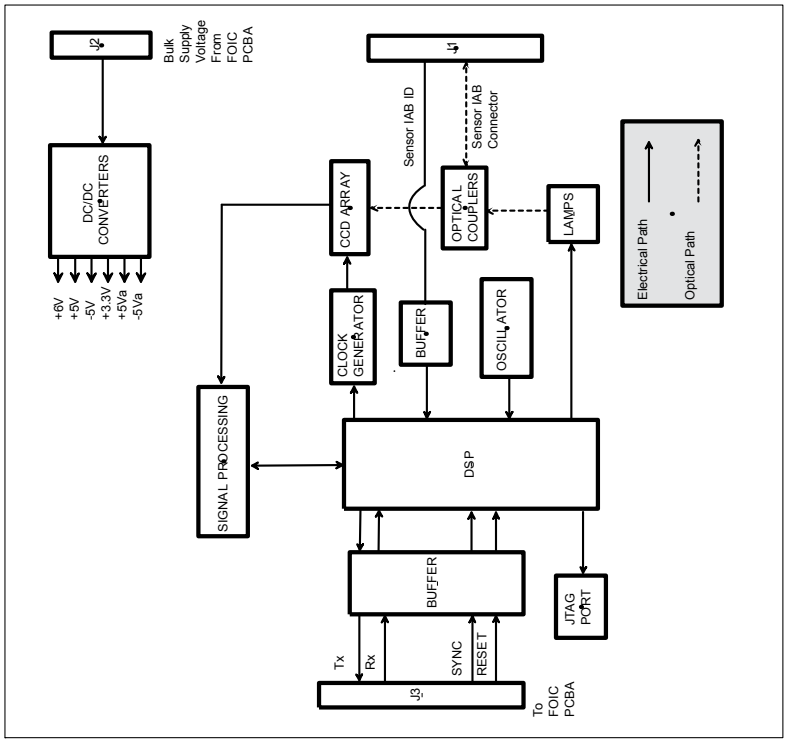


FIGURE 1-19 Sensor Module Block Diagram P/N 0997-00-1161

2.0 *Repair Information*

2.1 Introduction

This chapter of the Service Manual provides the necessary technical information to perform repairs to the instrument. The most important prerequisites for effective troubleshooting are a thorough understanding of the instrument functions, as well as an understanding of the theory of operation. Therefore, if necessary, refer to the Operating Instructions which describe the instrument functions and features, and the Theory of Operation section of this manual.

2.2 Safety Precautions

In the event that the instrument covers are removed, observe the following cautions and general guidelines.

CAUTION: Do not short component leads together.

CAUTION: The troubleshooting charts are not intended as a rapid course on how to repair devices of this type. Rather, they are intended as a guide for qualified technical personnel only. The instrument covers should only be removed by technically qualified personnel who have received supplementary instructions regarding maintenance of medical electronic equipment or have had equivalent experience in this area.

2.3 Troubleshooting Guidelines

In an instrument as complex as this, it is virtually impossible to list each and every potential problem and appropriate action. Any given problem, however, can be effectively identified through an understanding of the instrument features and the theory of operation. These are prerequisites for repair. If necessary, read the Operating Instructions and study the Theory of Operation section presented in this manual. The time spent reading and absorbing this information results in a reduction in repair time and, ultimately, an increase in the overall experience of service personnel.

General Troubleshooting Guidelines

1. **Identify the Problem.** Due to the wide range of potential symptoms, certain problems may be more subtle than others. As a first step towards problem identification, the instrument should be set-up and tested as described in section 4.3, "Calibration". If successful, there is a reasonable assurance that there is no problem. By contrast, the fact that a particular test is not successful is generally indicative of a failure in that specific area. The cause of the symptom can be further isolated by referring to the "Theory of Operation" section.
2. **Avoid Shorting Component Leads.** During a repair procedure it can become tempting to make a series of quick measurements. Always turn off the power before connecting and disconnecting test leads and probes.

CAUTION: The accidental shorting of component leads can easily over stress components, resulting in a second unnecessary failure (aside from creating a possible safety risk).

3. **Use the Proper Equipment.** The equipment listed in the next section is suggested to fulfill a wide range of troubleshooting requirements. Use a soldering iron with the appropriate wattage for a given job. For example, use a pencil-type iron (25 Watts max.) for repairs to printed wiring boards and a pistol-grip iron (75 Watts) for repairs requiring this much power.

CAUTION: To avoid damage, do not use the high powered iron to repair printed wiring boards as the conductors will lift from the surface under the extreme heat.

4. **Clean the Repair Area.** After soldering operations, clean off the repaired area with alcohol and a stiff hair brush. This will remove residual solder flux, making the repaired area more visible for inspection and returning the instrument to its original, neat appearance. Removal of the flux will also facilitate making electrical measurements in the affected area as the flux itself is not conductive.

2.4 Test Equipment and Special Tools Required

Test Equipment Required

- Dual trace oscilloscope
- Digital multimeter (3-1/2 Digits)
- ECG simulator and signal generator
- Digital Pressure Manometer, with ± 0.25 mmHg full scale accuracy, and the display resolution must have 2 decimal places. (i.e. 200.00 mmHg)

  Examples:

  (0-500mm range, F.S. accuracy .05% = ± 0.25 mmHg)

  (0-20PSI or 0-1034mmhg range, F.S. accuracy .025% = ± 0.25 mmHg)
- Safety analyzer
- Centimeter ruler
- System Trainer

Special Items Required

- Non-wired 1/4" stereo phone plug (P/N 0134-00-0016)
- 45.75 cc calibration chamber (P/N 0683-00-0314)
- 38.5 cc precision calibrated syringe (P/N 0453-00-0154)
- 60 cc syringe (P/N 0103-00-0026)
- Luer plug (P/N 0103-00-0211)
- Helium cylinder
- Catheter extender (P/N 0684-00-0182)
- 40 cc Datascope balloon
- Sensor Module Tester (P/N 0992-00-0245)
- Low Level Output Cable (0012-00-1589-02)
- Atmospheric transducer tubing adapter

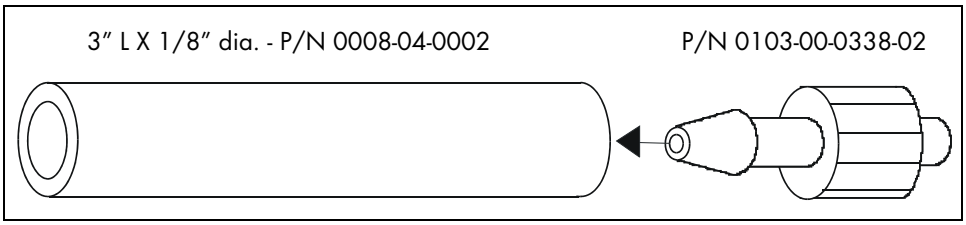


FIGURE 2-1 Atmospheric transducer tubing adapter

- 0 - 30 inch pound torque limiting screwdriver (with 4 mm hex bit)*
- Loctite #242 thread locker*

* Only required for compressor maintenance.

2.5 Troubleshooting Code Numbers

The following table contains 68020 Monitor CPU (Main PCB) error codes. These codes are output to the recorder for displays as "**Electrical Test Fails Code #__**".

CODE #	DESCRIPTION
1	Power up Watch-dog test failed
2	68020 CPU not functioning correctly
3	Boot checksum incorrect
4	Power up RAM test failed
5	68020 code transfer to DRAM did not verify correctly
6	Interrupt fault, 68020 exception condition during boot up

The following table contains the 6809 IABP CPU (Main PCB) error codes. These codes are displayed on the monitor in the alarm sections as "**Electrical Test Fails Code #__**".

CODE #	DESCRIPTION	CODE #	DESCRIPTION
21	ROM checksum test	39	Comm HC11 failed to interrupt 6809 and/or 68020 CPUs
22	System RAM address	40	IABP (6809) Datasette not compatible with 68020 Datasette
23	RAM walking ones	41	Monitor (68020) Datasette not compatible with 6809 Datasette
24	RAM pattern test	42	IABP (6809) Datasette not compatible with Front End HC11
25	UART comm. loop back test	43	IABP (6809) Datasette not compatible with Comm HC11
26	NMI test	44	IABP (6809) Datasette not compatible with Monitor/Keypad HC11
27	Watch-dog test	46	Monitor (68020) Datasette not compatible with Front End HC11
28	Start up test failure	47	Monitor (68020) Datasette not compatible with Comm HC11
29	IABP/Comm HC11 software flip-flop error at power up	48	Monitor (68020) Datasette not compatible with Monitor/Keypad HC11
30	Service diagnostics ROM failure	50	Motor speed out of specification
31	Not used	51	Adjusted motor speed out of specification
32	Power-up RAM test failure	52	Drive transducer offset failure
33	NMI detected during power up	53	Shuttle transducer offset failure
34	No comm. with 68020	54	ATM transducer calibration failure
35	No comm. with 6809	55	68020/6809 Sync failure entering system configuration mode
36	Software trap detected during power up	56	Excessive drive pressure
37	Soft interrupt during power up	57	Safety Vent test failed
38	Prolonged inflation test failure	58	Power-up Vent test failed

The following table contains the Communications CPU (68HC11 Main PCB) and the Front End board CPU error codes. These codes are displayed on the monitor.

CODE #	DESCRIPTION	CODE #	DESCRIPTION
61	Comm HC11 ROM test	92	Front End HC11 RAM address
62	Comm HC11 RAM address	93	Front End HC11 RAM walking ones test
63	Comm HC11 RAM walking ones test	94	Front End HC11 RAM pattern test
64	Comm HC11 RAM pattern test	98	Front End HC11 Watch-dog test
65	Comm HC11 shared RAM address	117	Front End A/D reference failure at power up
66	Comm HC11 shared RAM walking ones test	118	Front End HC11 can not communicate with Main HC11
67	Comm HC11 shared RAM pattern test	119	Front End CPU failure
68	Comm HC11 Watch-dog test	120	Monitor/Keypad CPU failure
69	Comm HC11 power up RAM test	122	Keypad did not respond to poll
70	Comm HC11 main failure	123	Invalid error condition
91	Front End HC11 ROM test		

The following table contains the Monitor/Keypad board CPU (68HC11 Monitor keypad) error codes. These codes are displayed on the Monitor keypad by illuminating an LED pattern.

LED PATTERN	DESCRIPTION
Pump Options/1:2	Power-up RAM test failure
Pump Options	ROM test failure
Aug. Alarm	System RAM address test failure
Aug. Alarm/Pump Options	System RAM walking ones test failure
1:3	System RAM pattern test failure
1:2	Watch-dog test failure
1:2/Aug. Alarm	Main Failure

During normal operation an alert message may be displayed as "**Maintenance Required Code #____**". These codes alert the operator that an internal failure may limit system performance and that the system should be serviced as soon as possible.

The following table contains the failure codes and the suggested action required to remedy the fault.

CODE #	DESCRIPTION	REMEDY
1	Atmospheric transducer offset failure	Calibrate the transducer as per section 4.0. If the transducer can not be calibrated, replace the Front End board.
2	Drive transducer offset failure	Calibrate the transducer as per section 4.0. If the transducer can not be calibrated, replace the pneumatic drive transducer.
3	Balloon transducer offset failure	Calibrate the transducer as per section 4.0. If the transducer can not be calibrated, replace the balloon transducer.
4	Compressor over-temperature condition	Verify that the compressor cooling fan (located inside the compressor assembly) is functioning. Ensure that air flow is not obstructed and vacuum excessive dust from the compressor.
5	Helium Pressure transducer out of calibration	Calibrate the transducer as per section 4.0.
7	Power Supply Fan failure	Clean the power supply as per section 5.6.7. If unit still has fan failure, replace power supply
8	FOS Module has a single lamp failure	Replace both lamps
9	FOS Module has a single lamp with low output upon power-up FOS Module has a lamp(s) with low output after power-up	Replace both lamps

2.6 Configuration DIP Switch (S2) Set-up on the Main Board

This DIP switch is used to provide default configuration information for the 68020 processor. The definitions of the bits within this buffer are summarized in the table below:

BIT #	FUNCTION
0	Modem type Bit 0
1	Modem type Bit 1
2	Modem type Bit 2
3	Modem type Bit 3
4	Language Bit 0
5	Language Bit 1
6	Language Bit 2
7	Language Bit 3

The S2 DIP Switch is located on the back of the Main Board. The Display PCB cover must be removed to view the DIP switch. It can be viewed via an access hole on the E-panel.

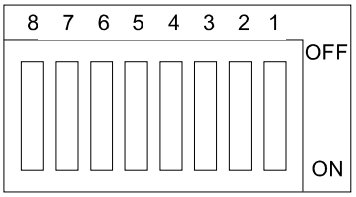


FIGURE 2-2 S2 DIP Switch

LANGUAGE OPTION SELECTIONS	S2-8	S2-7	S2-6	S2-5
ENGLISH	OFF	OFF	OFF	OFF
GERMAN	OFF	OFF	OFF	ON
FRENCH	OFF	OFF	ON	OFF
SPANISH	OFF	OFF	ON	ON
JAPANESE	OFF	ON	OFF	OFF
ITALIAN	OFF	ON	OFF	ON
PORTUGUESE	OFF	ON	ON	OFF
CHINESE	OFF	ON	ON	ON

2.7 System Configuration

See "System Configuration" in the **CS300** Operator's manual for information on the configuration of the following items:

- Language Selection
- Date Format Selection
- Modem Selection
- Display Software Revision
- 50/60 Hertz Filter Selection

2.8 Service Diagnostics

2.8.1 Introduction

Service Diagnostic software is resident within the **CS300**. It can be accessed at power up by pressing and holding the **Inflation Interval** and the **Freeze Display** keys on the Monitor keypad. Service Diagnostic software assists in the troubleshooting and performance verification of the **CS300**, thereby reducing downtime and simplifying maintenance procedures.

The Service Diagnostics allow for the verification and troubleshooting of the following sub-systems:

- Pneumatics
- Display
- Keypad/Control Switches
- Recorder
- RS-232 Port and Modem
- Autofill
- Sensor Module

Additionally, Service Diagnostics provide automated leak and performance tests, and an error log.

2.8.2 User Interface

All IABP controls become nonfunctional after entering Service Diagnostic mode. All Service Diagnostic user input is provided through the keys indicated by the black arrows in FIGURE 2-3.

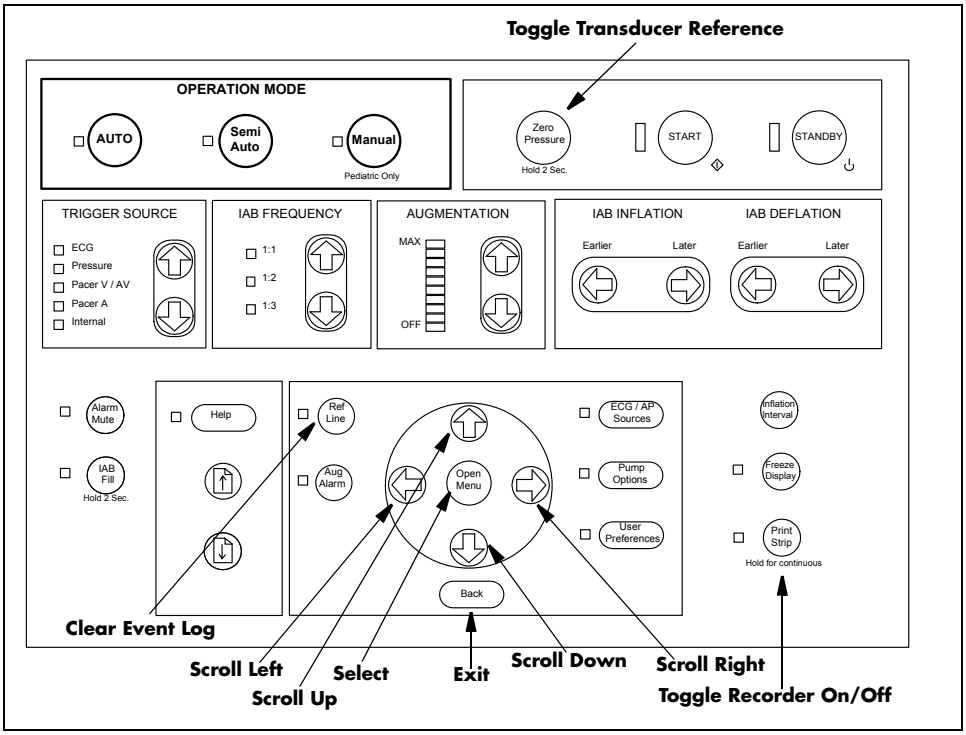


FIGURE 2-3 User Interface

To enter the Service Diagnostics, press and hold the **INFLATION INTERVAL** and the **FREEZE DISPLAY** keys on the Monitor keypad while powering on the **CS300**. Continue to hold the keys until the Datascope logo is displayed. Following, the logo, the warning screen is displayed:

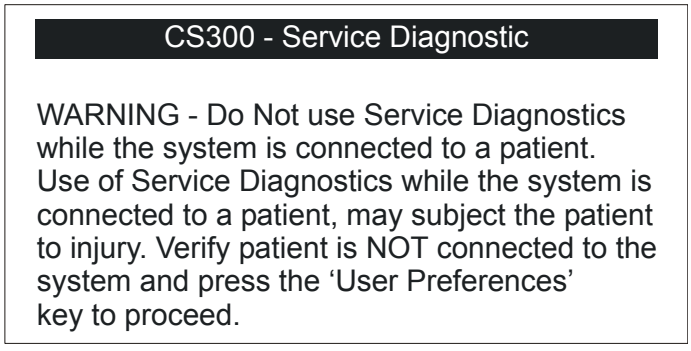

CS300 - Service Diagnostic
WARNING - Do Not use Service Diagnostics while the system is connected to a patient. Use of Service Diagnostics while the system is connected to a patient, may subject the patient to injury. Verify patient is NOT connected to the system and press the 'User Preferences' key to proceed.

FIGURE 2-4 Service Diagnostic Warning

After verifying that the patient is NOT connected to the system and then pressing the "User Preferences" key, the software automatically performs a series of start-up tests. When the start-up tests have completed, the Main Menu (title screen) is displayed as shown in FIGURE 2-5.

2.8.3 Main Menu

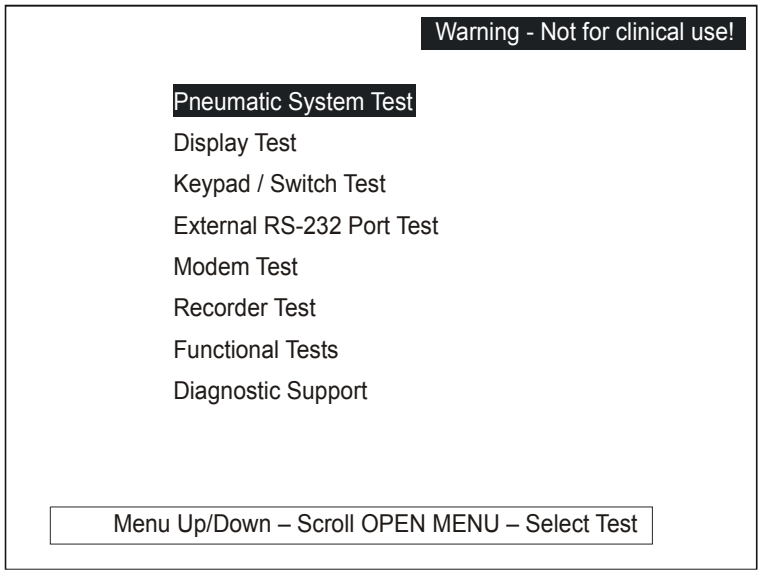


FIGURE 2-5 Main Menu

Pressing the **OPEN MENU UP** or **DOWN** keys will scroll through and highlight the individual menu items. Pressing the **OPEN MENU** key will activate the highlighted menu item.

NOTE: The Main Menu will be displayed after exiting any of the individual selections.

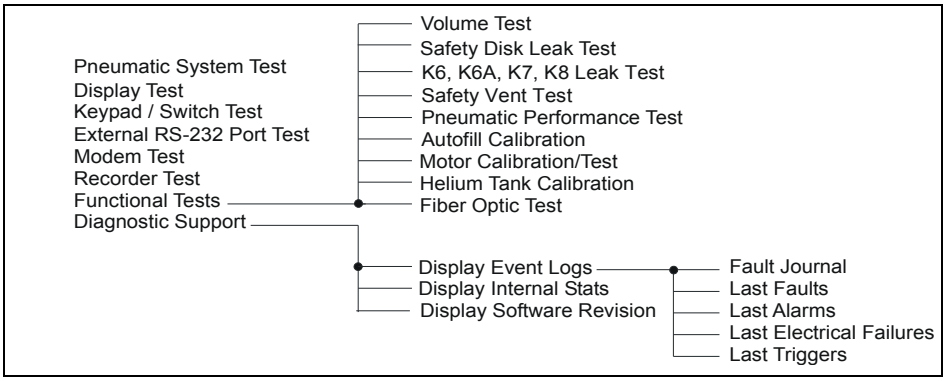


FIGURE 2-6 Service Diagnostic Menu Tree

2.8.3.1 Pneumatic System Test

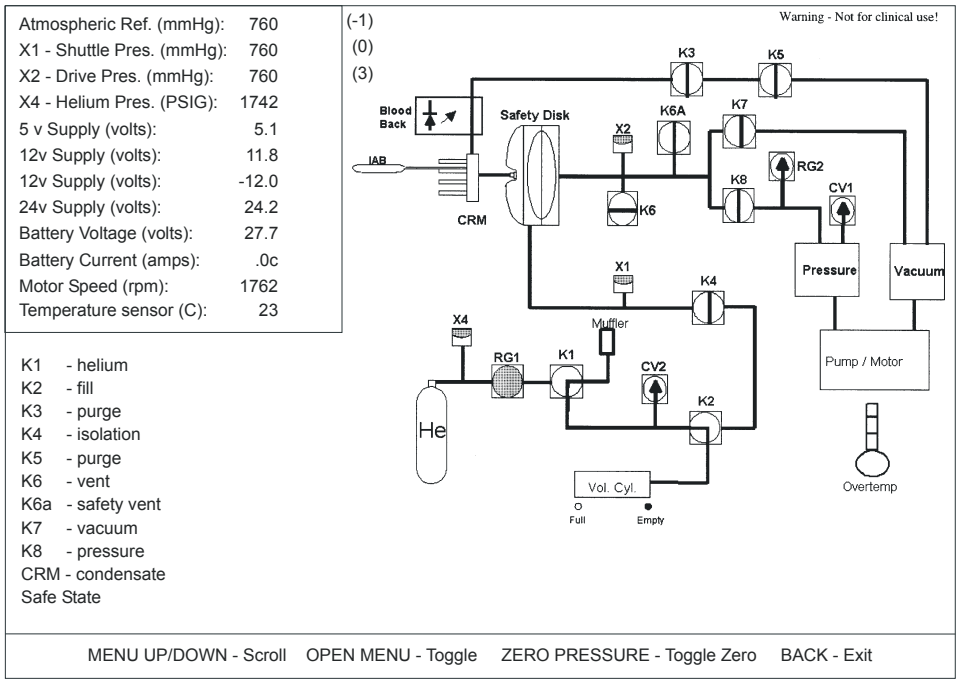


FIGURE 2-7 Pneumatic System Test Screen

The Pneumatic System Test screen is a schematic representation of the **CS300** pneumatics. This test screen can be used to leak test solenoids, verify transducer calibration, regulator outputs, solenoid control lines, and pneumatic switch operation.

Solenoid references (K1 - K8) are displayed on the left hand side of the screen. The **MENU UP** and **DOWN** keys on the keypad are used to highlight a particular solenoid. Pressing the **OPEN MENU** key will then toggle (activate/deactivate) the highlighted solenoid. Any combination of solenoids can be activated. Once a solenoid is activated the associated reference is displayed in reverse graphics. A continuous line drawn through a solenoid indicates that it has been set to allow flow through it.

NOTE: **The software prohibits the user from simultaneously activating more than one of the K6, K7 or K8 solenoids. It also automatically deactivates any of those three if they are left active for more than 5 minutes.**

Transducer outputs, power supply voltages, battery voltage, battery current, motor speed, and temperature sensor reading are displayed in the measurement box in the upper left corner of the display. Pressure is displayed in units of millimeters of mercury (mmHg), except for the helium tank pressure (X4) which is displayed in pounds per square inch (PSIG).

When the Pneumatic System Test is first activated the atmosphere, shuttle and drive transducer outputs are displayed as absolute values. The transducers can be zeroed (referenced to atmospheric pressure) by pressing the **ZERO PRESSURE** key.

After start-up and autofilling, the shuttle and atmospheric transducers are compared to the drive transducer. The values are then compensated so that the shuttle and atmospheric transducers are equal to the drive transducer at atmospheric pressure. The offset difference from the drive transducer is displayed in brackets ( ) next to the shuttle and atmospheric pressure readings.

The numbers in brackets ( ) next to the helium pressure indicate the helium pressure offset. If the calibration is out of specification, (xx) will be displayed. This will also cause the message **Maintenance Required Code 5** to be displayed during the normal operating mode of the IABP.

The transducer outputs can be converted to other pressure units using the following conversions:

____ mmHg (0.0394) = inHg ____ inHg (25.4) = mmHg

____ mmHg (0.0193) = PSI ____ PSI (51.7) = mmHg

____ mmHg (0.00132) = Atm ____ Atm (760) = mmHg

The battery current reading is followed by "c" for charging or "d" for discharging. It is normal for the current to read ".0c" when the battery is in trickle charge mode.

The temperature sensor is the internal temperature of the unit in degrees (°) Celsius.

Refer to Component Descriptions listed below.

Component Description/Service Diagnostics Pneumatic Screen

DESIGNATION	DESCRIPTION
K1	3-way solenoid valve that either supplies helium or vents to atmosphere the normally open port of K2
K2	3-way solenoid valve that connects the volume cylinder to either the helium source (inactive) or to the Safety Disk via K4 (active)
K3	2-way normally closed solenoid valve, when open allows the fill and IAB circuits to be purged
K4	2-way normally closed solenoid valve that isolates the Safety Disk/IAB circuit from the rest of the fill system
K5	2-way normally closed solenoid valve, when open allows the fill and IAB circuits to be purged
K6	2-way normally closed solenoid valve used to vent the Safety Disk (drive side) to atmosphere prior to deflation in order to conserve vacuum, also vents the Safety Disk during purge
K6A	2-way normally open solenoid, closed during normal operation, functions as a safety vent for the Safety Disk
K7	2-way normally closed solenoid, when active, vacuum is applied to the Safety Disk (drive side)
K8	2-way normally closed solenoid valve, when active, allows pressurization of the Safety Disk (drive side), causing the IAB to inflate

Component Description/Service Diagnostics Pneumatic Screen (Continued)

DESIGNATION	DESCRIPTION
RG1	Two-stage helium pressure regulator
RG2	7.75 PSI back pressure regulator limits the drive pressure by venting excess pressure to atmosphere
CV2	4.5 PSI relief valve to prevent overpressure in the helium supply
CV1	9 PSI relief valve used as a fail-safe to prevent the drive pressure from exceeding 9 PSI in the event of RG2 failure
X1	Balloon transducer - used to monitor IAB shuttle gas for purposes of leak detection and auto filling
X2	Drive gas transducer - used to monitor Safety Disk drive pressure for the purposes of leak detection and drive pressure/vacuum alarms
X4	Transducer that monitors helium tank pressure
FULL	Hall effect sensor, when active, the Volume chamber is filled (or in the FULL position) to the preset volume of gas
EMPTY	Hall effect sensor, when active, the Volume chamber is empty or in the Home position
MUFFLER	Mufflers used to reduce noise generated by exhaust gases (via RG2, K6) and the pump
VOLUME CYLINDER	Variable volume chamber, when filled contains the preset volume of Helium gas used to fill the shuttle gas system
BLOOD BACK	Blood Back Optical Sensor - Part of solenoid driver board
PRESSURE	Pressure reservoir
VACUUM	Vacuum reservoir
DC MOTOR /PUMP	DC motor combined with compressor/aspirator
FILTER	40 micron filter for the pressure source
SAFETY DISK	Safety Disk/Condensate Removal Assembly

2.8.3.2 Display Test

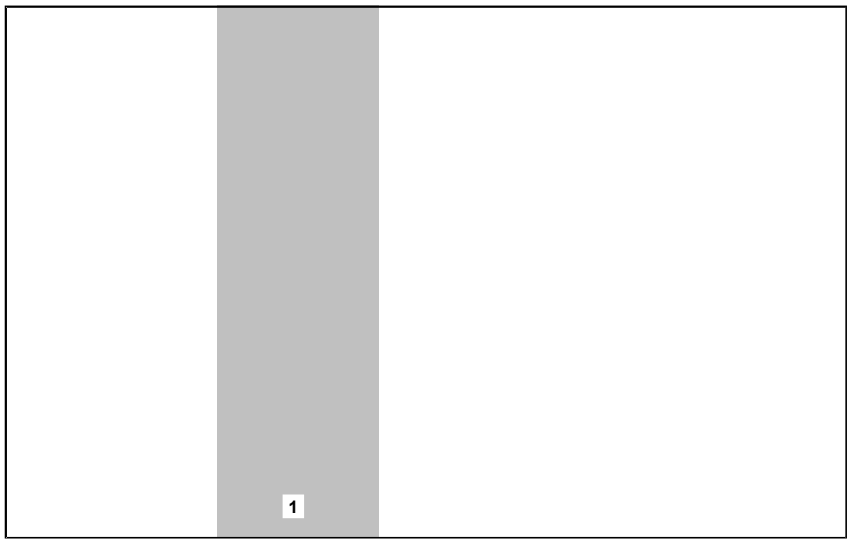


FIGURE 2-8 Display Test

The Display Test is used to verify the proper operation of the display, the Display board and the associated interconnecting cables. The test is made up of four individual checks.

When the Display Test is first selected, a movable variable intensity vertical bar is displayed. The bar is 130 pixels wide by 480 pixels high and can be swept across the screen from left to right by pressing the Open Menu **LEFT** and **RIGHT ARROW** keys. The bar is annotated with the intensity level (annotation is in reverse video) near the bottom of the bar. The intensity level can be changed by pressing the **OPEN MENU** key. The range of intensity is from 0 (dimmest) to 2 (brightest).

1. Press the **REF LINE** key to test the Base Screen Memory. In this test, the screen is illuminated from the top to the bottom of the display. At the conclusion of the test, the message "**Base Screen Memory OK**" is displayed.

NOTE: Pressing the BACK key during the memory test causes an abort message to appear followed by the return to the main menu. If an error occurs during the test, a message is displayed identifying the location of the error.

2. Press the **REF LINE** key again to test the Window Screen Memory. In this test, the screen is illuminated from the top to the bottom of the display. At the conclusion of the test, the message "**Window Screen Memory OK**" is displayed.

NOTE: Pressing the BACK key during the memory test causes an abort message to appear followed by the return to the main menu. If an error occurs during the test, a message is displayed identifying the location of the error.

3. Press the **BACK** key to return to the Main Menu.

2.8.3.3 Keypad / Switch Test

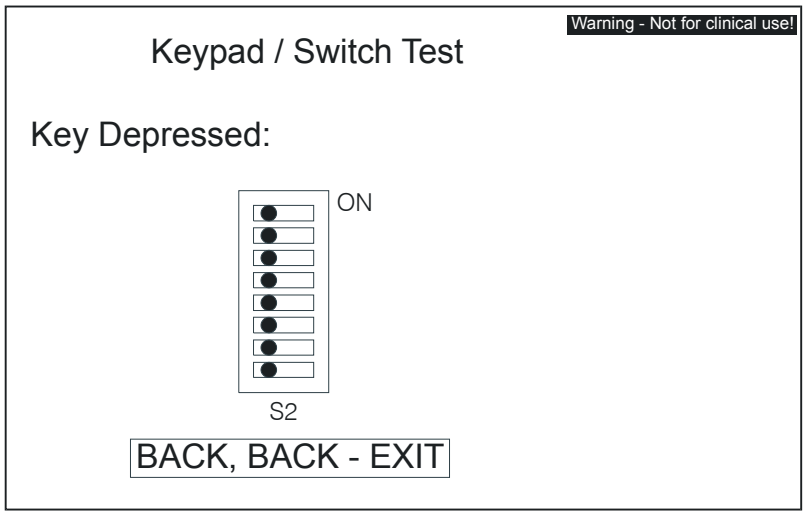


FIGURE 2-9 Keypad / Switch Test Screen

The Keypad / Switch Test is provided to verify the operation of all front panel switches.

All keys are identified and displayed on screen in the area labeled **Key Depressed**.

Keypad LEDs are lit when their corresponding keys are pressed. If multiple LEDs are associated with a key, such as the augmentation bar, all will light simultaneously.

S2 is the eight position DIP switch located on the Main Board. This switch is used to configure **CS300** default options.

Press **BACK** twice to return to the Main Menu.

2.8.3.4 External RS-232 Port Test

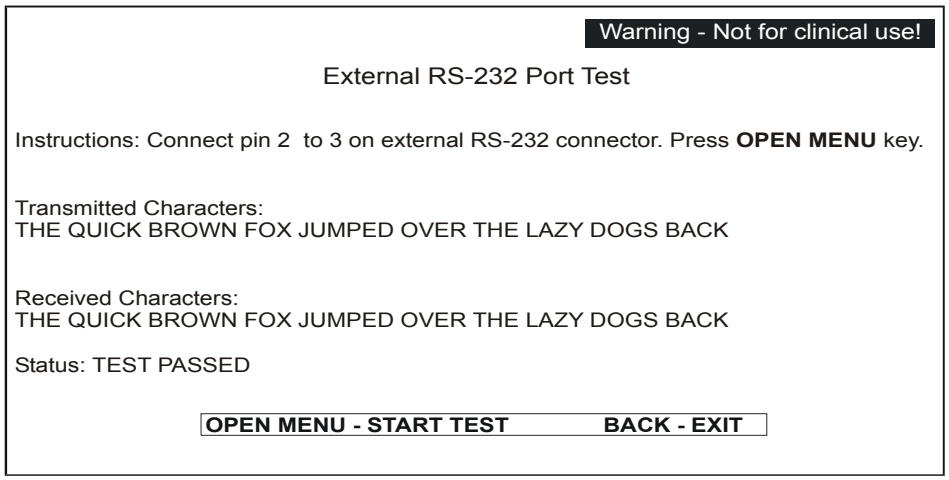
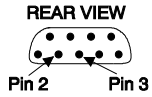

Warning - Not for clinical use!
External RS-232 Port Test
Instructions: Connect pin 2 to 3 on external RS-232 connector. Press OPEN MENU key.
Transmitted Characters:
THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
Received Characters:
THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
Status: TEST PASSED
OPEN MENU - START TEST
BACK - EXIT

FIGURE 2-10 RS-232 Test Screen

The purpose of this test is to verify the integrity of the RS-232 channel. The user will be instructed to jumper the transmit and receive pins together on the rear panel RS-232 connector. This action will allow the serial communication channels to transmit data and receive back the data that is sent.

1. Use bus wire to jump pins 2 and 3 (transmit and receive lines) of the rear panel RS-232 connector together.



2. Press the **OPEN MENU** key to run the test. Transmitted characters are compared to received characters until the entire test string "**THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK**" has been sent.
3. The **Status** line will indicate if the test passes. If the data is received incorrectly or data is missing, the test will fail and display "**Incorrect or no characters received**". The test will also fail if the transmit and receive pins are not jumped together.
4. Press the **BACK** key to exit the test.

2.8.3.5 Modem Test

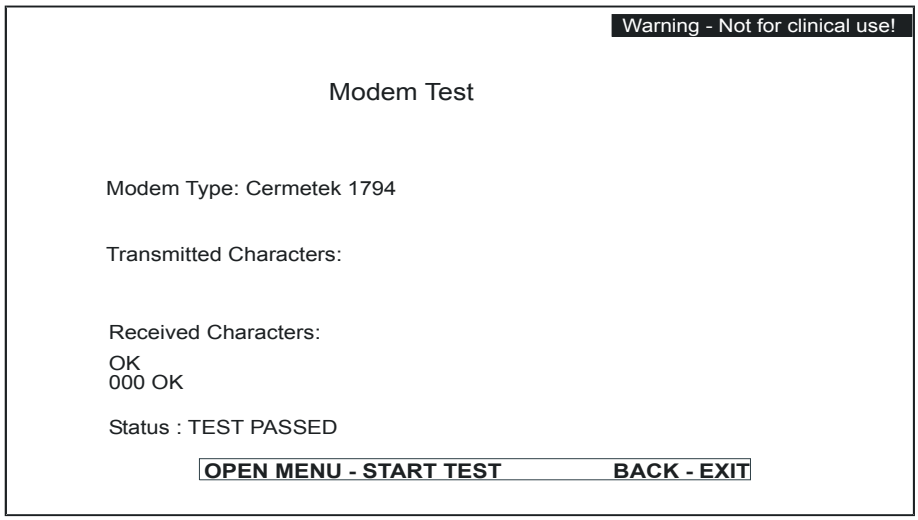


FIGURE 2-11 Modem Test Screen for Cermetek Modem

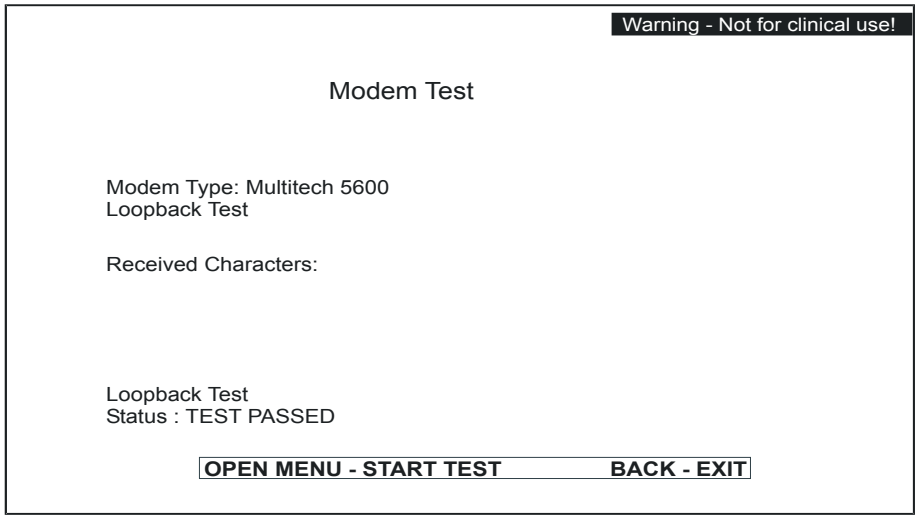


FIGURE 2-12 Modem Test Screen for Multitech Modem

The Service Diagnostic Modem Test is designed to check the integrity of the internal modem by using the modem's built-in diagnostic test. The test will report the number of errors detected (3 digit number above status) and pass/fail status.

The modem set-up is accessed via the system configuration mode. See "System Configuration" in the **CS300** Operator's manual for more details.

Press **BACK** to exit the test.

2.8.3.6 Recorder Test

The Recorder Test is designed to verify the functionality of the System recorder. The Service Diagnostic software is designed to send data to the recorder that will verify the ability to print waveforms, grids, and ASCII characters. A chart speed of 25 mm/sec is used. A centimeter ruler is required for this test. Select the **Recorder Test** from the Main Menu and press the **OPEN MENU** key to initiate. The recorder will automatically run and the following tests will be performed:

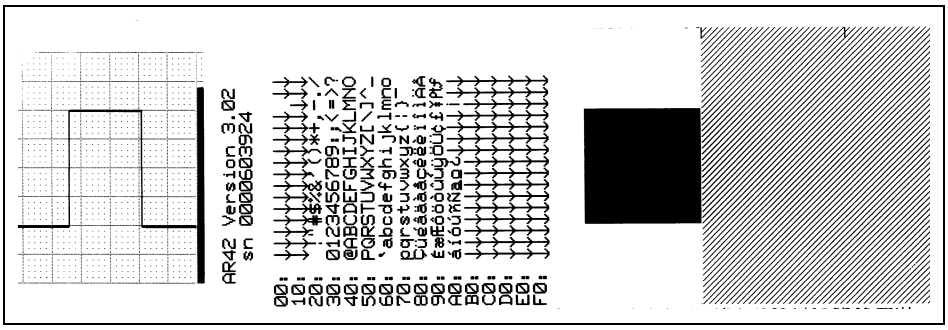


FIGURE 2-13 Recorder Test Strip

1. 5 mm grid is printed with 1 mm subdivisions. Measure the span of 10 grids and verify that it is equal to 5 cm.
2. Verify that the 60 bpm square wave is 2 cm peak to peak, and one cycle is 25 mm wide.
3. A solid bar is printed, examine the bar and ensure that all of the pixels are operating.
4. Verify that the character set is printed as shown in FIGURE 2-13.

2.8.3.7 Functional Tests

The functional test screen is a submenu made up of 8 individual automated tests:

1. Volume Test
2. Safety Disk Leak Test
3. K6, K6A, K7, K8 Leak Test
4. Safety Vent Test
5. Pneumatic Performance Test
6. Autofill Calibration
7. Motor Calibration/Test
8. Helium Tank Calibration
9. Fiber Optic Test

Press the **OPEN MENU UP** and **DOWN** keys to highlight each individual test.

Press the **OPEN MENU** key to activate the highlighted selection.

Press the **BACK** key to exit the Functional Tests and return to the title screen.

Press the **PRINT STRIP** key to toggle the recorder on and off.

2.8.3.7.1 Volume Test

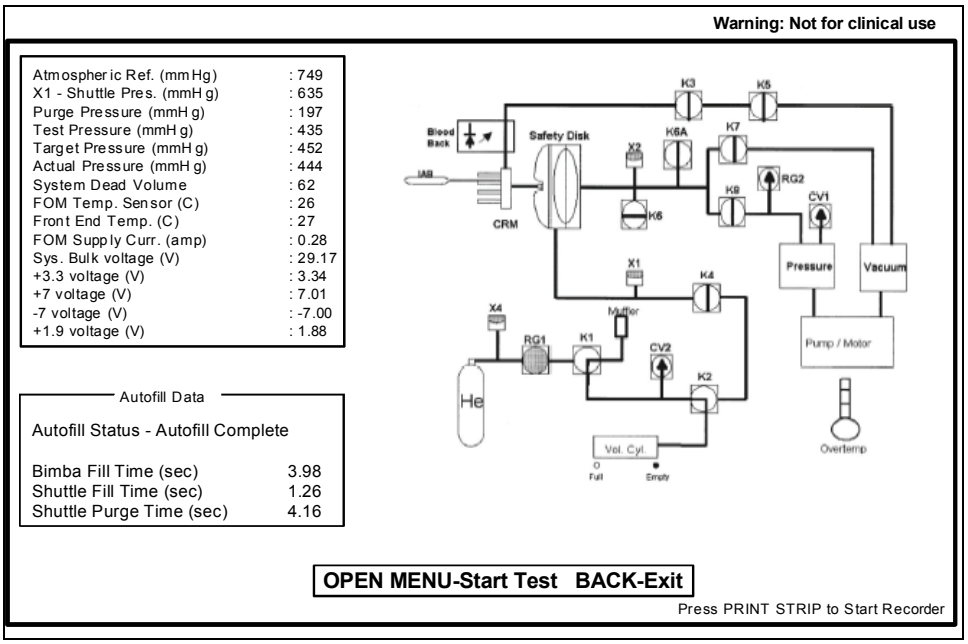


FIGURE 2-14 The Volume Test

The Volume Test was designed for engineering purposes. The results may be required from time to time by engineering, however other than the Autofill Status, there is no other information here that would provide technicians with any meaningful results.

1. To perform the autofill test for status purposes, follow the next steps. Insure there is adequate helium pressure.
2. Attach the 6-foot catheter extender and 40cc IAB to the Safety Disk Assembly.
3. Press the **OPEN MENU** key to start the test. The Autofill Data box will display a test status message which indicates the stage of the autofill process. If an autofill failure occurs, a status message is posted describing the failure.
4. The test performs two autofill cycles. After the 1st autofill, the IAB is partially inflated for the duration of the 20 seconds followed by the 2nd autofill. Use the data from the second autofill for Autofill Status results.

2.8.3.7.2 Safety Disk Leak Test

This test is functionally equivalent to the leak test that is included in the **CS300** operating software. The primary differences are, the ability to halt a test in progress by pressing the **BACK** key, and the display of test status messages and elapsed time. Three separate leak tests are performed. First, K3 is activated thereby pneumatically removing it from the circuit. The system checks for a vacuum leak, which could be caused by a hole in the Safety Disk membrane or a leak through the K5 solenoid. After two minutes, K3 is de-activated (closing the valve) and K5 is activated (pneumatically removing it from the circuit). The system again checks for vacuum leaks which could be caused by a hole in the Safety Disk membrane or a leak through the K3 solenoid. After two minutes, K5 is de-activated (closing the valve) and K8 is activated causing the Safety Disk to pressurize. The third test will then begin.

During the test, status messages will inform the user when portions of the tests are completed. At the conclusion of each test, the pressure change is posted. If an adult Safety Disk is used, a change that is greater than ±4 mmHg for any of the tests indicates that there is a leak in the system. Using an adult or pediatric Safety Chamber, changes that are greater than ±6 mmHg and ±10 mmHg respectively indicate that there is a leak in the system. These thresholds are displayed while the test is active.

The protection circuitry associated with K7 and K8 may also be tested from this menu. These circuits provide an additional level of protection for the patient by guaranteeing that the IAB may never be held inflated longer than approximately two (2) seconds. Pressing the **START** key activates K8 continuously. Pressing the **IAB FILL** key pulses K8 without activating K7. Either test is terminated when the circuitry times out, or upon failing the test. If the test passes, the solenoids are returned to their inactive states, an alarm tone sounds, and additional commands to the solenoids are inhibited. System power must then be cycled for testing to continue. Failure of the test will not require the system power to be cycled.

NOTE: These tests may be run independently of the Safety Disk Leak Test.

1. Select Functional Tests from the Main Menu and then select **Safety Disk Leak Test** from the submenu.
2. With the IAB catheter port of the Safety Disk unplugged, press the **OPEN MENU** key to start the test. Wait for a tone to sound and for the instruction "**Plug Safety Disk**" to be displayed. Immediately seal the IAB catheter port using the luer plug. If the test is started with the IAB port already plugged, the instruction "**Unplug Safety Disk**" is displayed. Unplug the port and wait for the "**Plug Safety Disk**" instruction. The test will take approximately 6.5 minutes to complete.

NOTE: **In order to test both protection circuits for steps 3 and 4, the CS300 must be powered OFF after the first test is completed and the loud alarm tone is sounded. The unit can then be re-powered ON into service diagnostics. Perform the Safety Disk Leak Test again, and perform the second protection circuit test.**

3. Press the **START** key to begin testing the protection circuitry. After a few seconds, the test status will be displayed. A loud alarm tone will sound if the test passes, requiring cycling of the system power to reset the protection circuitry and alarm.
4. Press the **IAB FILL** key to begin the second test of the protection circuitry. After a few seconds, the test status will be displayed. A loud alarm tone will sound if the test passes, requiring cycling of the system power to reset the protection circuitry and alarm.

2.8.3.7.3 K6, K6A, K7, K8 Leak Test

This test checks for leaks in the drive section of the **CS300** pneumatics. The drive section is first vented to atmosphere and held for 60 seconds, then pressurized to approximately 8 PSI. It is held for 60 seconds and then evacuated and held for 60 seconds. X2, the drive transducer is read to determine the pressure during these periods. The pneumatic schematic is displayed on screen along with the measurement box and a test status box. The test status box contains the current status of the test, the pressure difference from start to end of test and the elapsed time (in seconds).

1. Select **Functional Tests** from the Main Menu and then select **K6, K6A, K7, K8 Leak Test** from the submenu.
2. With the IAB catheter port of the Safety Disk unplugged, press the **OPEN MENU** key to start the test. Wait for a tone to sound and the instruction "**Plug Safety Disk**". Seal the IAB catheter port using the luer plug. If the test is started with the IAB port already plugged, the instruction "**Plug Safety Disk**" will not appear and testing will proceed.
3. At the start of the test, K3 and K5 are activated to purge the shuttle side of the Safety Disk to below 200 mmHg, and K6 is activated until the drive pneumatics are vented to atmosphere. When these levels are reached, K3, K5 and K6 are deactivated and K6A is activated. This first portion of the test is 60 seconds in length and checks for leaks at K7 and K8. After 60 seconds of Elapsed Time, the timer stops and the differential pressure is posted in the Test #1 section.

   The timer restarts and the second portion of the test activates K8 to pressurize the drive side of the Safety Disk to approximately 8 PSI. This portion of the test is 60 seconds in length and checks for leaks to atmosphere through K6 or K6A, or a vacuum leak through K7. At 120 seconds of Elapsed Time, the timer stops and the differential pressure is posted in the Test #2 section.

The timer restarts and the third portion of the test rapidly toggles K6A and K7 until a partial vacuum is achieved. This portion of the test is 60 seconds in length and checks for leaks to atmosphere through K6 or K6A, or a pressure leak through K8. At 180 seconds of Elapsed Time, the timer stops and the differential pressure is posted in the Test #3 section.

TEST	ACCEPTABLE LEVEL
TEST # 1	±45 mmHg
TEST # 2	±65 mmHg
TEST # 3	±20 mmHg

4. Press the **BACK** key to return to the Functional Tests screen.

2.8.3.7.4 Safety Vent Test

This test checks for obstructions in the Safety Vent (K6A) path. Failure of this test could be caused by the failure of K6A or an obstruction or kink in the safety vent tubing. Upon initiating this test, a vacuum is applied to purge the patient side of the Safety Disk, and the drive side of the Safety Disk is vented to atmosphere. Pressure is then applied to the Safety Disk for approximately two (2) seconds. This is followed by venting the drive manifold to atmosphere by opening of Safety Vent K6A. The measured vent time, start pressure and ending pressure are posted. The test passes if the drive manifold pressure drops to approximately 150 mmHg above atmosphere in less than two (2) seconds.

1. Select Functional Tests from the Main Menu and then select Safety Vent Test from the submenu.
2. Press the **ZERO PRESSURE** key.
3. Press the **OPEN MENU** key to initiate the test.
4. Press the **BACK** key to return to the Functional Tests screen.

2.8.3.7.5 Pneumatic Performance Test

1. Select **Functional Tests** from the Main Menu and then select **Pneumatic Performance Test** from the submenu.
2. Press the **ZERO PRESSURE** key to display pressure readings referenced to atmospheric pressure. Verify that the catheter input port of the Safety Disk is open to atmosphere.
3. Press the **OPEN MENU** key to start the test. The system begins to pump at 150 bpm for 30 seconds.
4. Once the system stops pumping, observe the vacuum recovery time display window. This period should be less than 10 seconds.
5. Verify that the average pressure reads between 300 and 413 mmHg. A lower reading may indicate a leak in the pneumatic system, a need to adjust the 8 PSI regulator, a flow restriction in the pressure line (clogged muffler), or the need to rebuild the pump motor. A higher reading indicates a problem with the 8 PSI regulator or the need to adjust it.
6. Verify that the average vacuum reads a minimum of -176 mmHg* (a lower number indicates more vacuum). A higher reading may indicate a leak in the pneumatic system or the need to rebuild the compressor.

7. Verify the minimum acceptable levels as shown in the following table:

PARAMETER	ACCEPTABLE LEVEL	REMARKS
First Inflate Delay (ms)	< 24 msec	Time from inflate command until the diaphragm begins to move
First Deflate Delay (ms)	< 24 msec	Time from deflate command until the diaphragm begins to move
Max. Vacuum (mmHg)	< -200 mmHg	Max. peak vacuum
Avg. Vacuum (mmHg)	< -176 mmHg*	Average vacuum
Max. Pressure (mmHg)	< 436 mmHg	Max. peak pressure
Avg. Pressure (mmHg)	300 to 413 mmHg	Average Pressure
Inflate Transition (ms)	< 36 msec	Time to exceed 75% of peak pressure
Deflate Transition (ms)	< 36 msec	Time to exceed 75% of peak vacuum
Recovery Time (secs)	< 10 sec	Time to reach 150 mmHg (absolute)

* *-176 mmHg at sea level. See chart for acceptable average vacuum levels at higher elevations.*

Average Vacuum Levels

ALTITUDE (ft)	ATMOSPHERE (mmHg)	AVERAGE VACUUM (mmHg)
0	760	-176
1000	732	-163
2000	704	-148
3000	680	-137
4000	656	-125
5000	630	-111
6000	608	-101
7000	586	-90
8000	564	-80
9000	543	-69
10000	523	-60
11000	504	-51
12000	483	-40

8. Press the **BACK** key to return to the Functional Tests.

2.8.3.7.6 Autofill Calibration

This test simplifies the autofill calibration process. The routine is identical to the Autofill Test except that after filling the Safety Disk with helium, it is left in a pressurized state by activating the K8 (pressure) solenoid. See "Calibration" on page 4-4 for the complete calibration procedure using this test.

2.8.3.7.7 Motor Calibration/Test

This test verifies the integrity of the motor speed circuitry on the Main Board, the Motor Controller board, the DC motor and the associated cables and connectors. The test is separated into four parts.

1. Attempt to set the motor speed to 1600 RPM by applying 8 volts to the Motor Controller board.
2. Verify that the actual speed is within 20 percent of 1600 RPM.
3. Re-adjust the motor speed by calculating the necessary scale factor based on the actual speed.
4. Verify that the adjusted speed is within 3 percent of 1760 RPM.

Results can be printed to the recorder by pressing the **PRINT STRIP** key.

2.8.3.7.8 Helium Tank Calibration

This test calibrates the helium pressure circuit.

1. Close the helium tank valve and remove the helium tank from the pump.
2. Press **OPEN MENU** to start the test. The helium offset is displayed. If the offset is too large, an "**Out of Specification**" message is displayed. If the offset is within the limits, a "**Within Specification**" message is displayed.

2.8.3.7.9 Fiber Optic Test Instructions

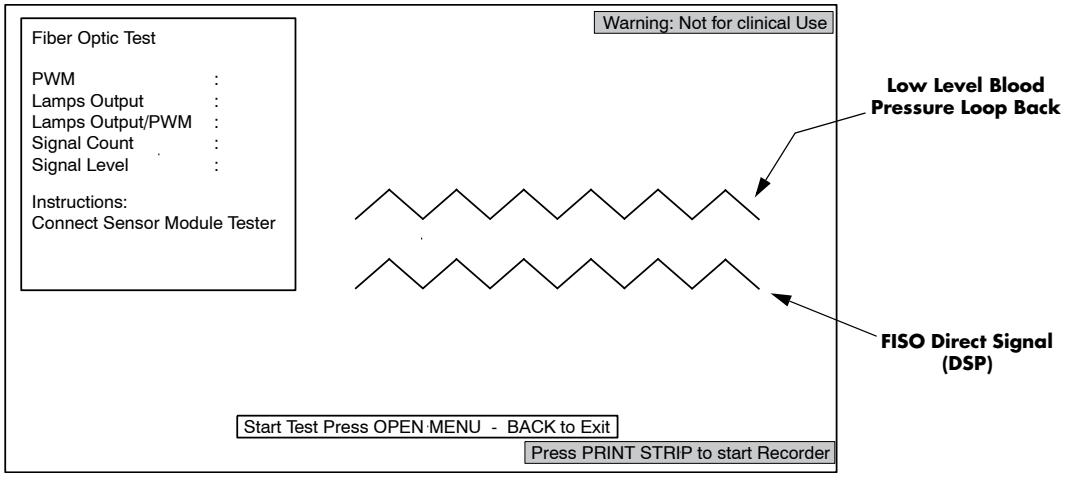

Fiber Optic Test
PWM :
Lamps Output :
Lamps Output/PWM :
Signal Count :
Signal Level :
Instructions:
Connect Sensor Module Tester
Warning: Not for clinical Use
Low Level Blood Pressure Loop Back
FISO Direct Signal (DSP)
Start Test Press OPEN MENU - BACK to Exit
Press PRINT STRIP to start Recorder

FIGURE 2-15 Fiber Optic Test

The purpose of the Fiber Optic Test is to verify the lamp function and output, Pulse Width Modulation (PWM), Signal Count, and Signal Level of the Sensor Module. This test will run for 30 seconds. The Sensor Module Tester (0992-00-0245) and a Low Level Output Cable (0012-00-1589-02) are required for this test.

1. Connect the Sensor Module Tester by inserting the Fiber Optic Connector into the IAB Sensor Input connector and connecting the tubing/luer connector to the IAB Catheter Extender Input connector.

2. Connect the Low Level Output cable between the Low Level Output from the Sensor Module (labeled "TO BEDSIDE MONITOR") and the Blood Pressure Input connector on the **CS300**.
3. Power ON the **CS300** into Service Diagnostics. Select the **FIBER OPTIC TEST** from the **FUNCTIONAL TESTS** menu.
4. Press the **OPEN MENU** to enter the test.
5. Press the **OPEN MENU** key to start the test. The unit will start pumping and display two waveforms. The two waveforms should be alike.
6. After 30 seconds, the pumping will stop and the parameters will be displayed. The test results, FOS errors, or Test Complete will be displayed as depicted in the example of FIGURE 2-16.

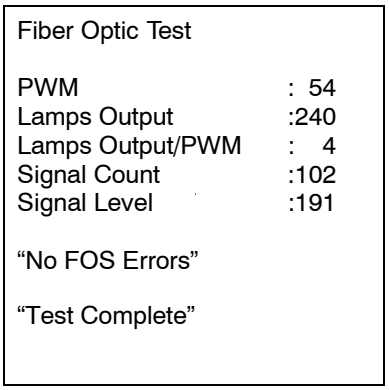


FIGURE 2-16 Example Fiber Optic Test Results

The pass / fail criteria are as follows:

PWM:	1 - 69
Lamps Output:	0 - 248
Lamps Output/PWM:	> = 3
Signal Count:	> = 55
Signal Level:	> = 153

7. If any of the first three parameters fail, then Fiber Optic Lamp Replacement is recommended (see section 5.6.9).
8. If "Sig Count" or "Sig Level" fail, then perform the Lamp Ferrule cleaning procedure (see section 5.6.8) and retest. If failure persists, replace module and retest.

2.8.3.8 Diagnostic Support

The Diagnostic Support menu contains the following submenus:

- Display Event Logs
- Display Internal Statistics
- Display Software Revision

2.8.3.8.1 Display Event Logs

From the Main Menu select **DIAGNOSTIC SUPPORT**. From the submenu select **DISPLAY EVENT LOGS**.

Fault Journal

The **CS300** maintains an event log in non-volatile RAM located on the Main Board. In the Fault Journal, the display shows the fault number and the number of times the fault has occurred. Pressing the **PRINT STRIP** key will print the fault log on the recorder.

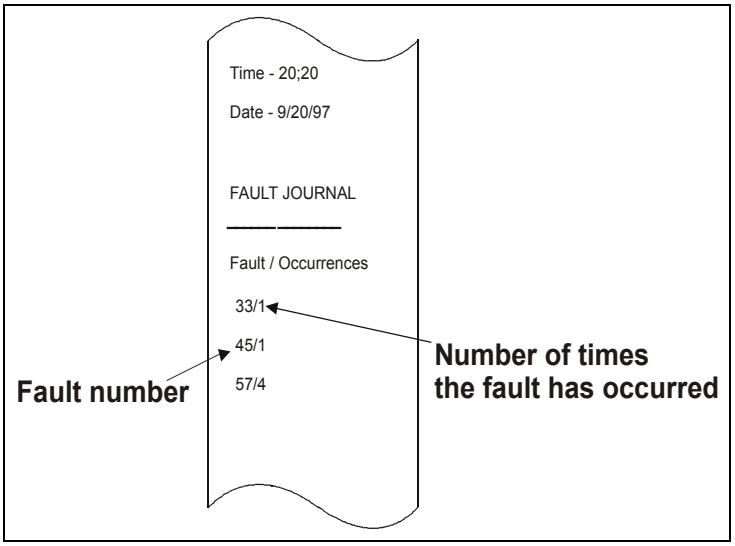


FIGURE 2-17 Fault Log Recorder Strip

Last Faults

Press the **OPEN MENU** key to display the time and date of the last 20 faults, as well as more detailed information on Autofill failures. Press the **PRINT STRIP** key to print the last 20 failures to the recorder.

NOTE: **This screen allows the internal statistics to be cleared by pressing the REF. LINE key twice. This should only be done if the non-volatile RAM has been corrupted or the Main Board has been replaced.**

The following is a list of Main Board fault codes.

FAULT INDEX	DESCRIPTION	SYSTEM RESPONSE
01	RTOS and virtual device manager faults	fault is logged
02	Set Model Type Fault	System shutdown
03	VRTX error return faults	fault is logged
04	Display interface fault	fault is logged
05	ACRTC driver fault	fault is logged
06	ACRTC controller fault	fault is logged
07	Communications faults	fault is logged
08	In-process BIT checksum fault	68020 resets
09	In-process BIT half way stack probe fault	fault is logged
10	In-process BIT 80% stack probe fault	68020 resets
11	In-process BIT A/D reference voltage fault	fault is logged

FAULT INDEX	DESCRIPTION	SYSTEM RESPONSE
12	In-process BIT A/D interrupt frequency fault	fault is logged
13	In-process BIT timer manager interrupt freq. fault	fault is logged
14	In-process BIT VRTX timer interrupt freq. fault	fault is logged
15	Real-time clock ISR fault	68020 resets
16	68020 CPU test fault	68020 resets
17	Display controller test fault	fault is logged
18	A/D reference test fault	fault is logged
19	Recorder test fault	fault is logged
20	Comm fault	fault is logged
21	Comm fault	fault is logged
22	Deadman timer real-time clock service routine fault	68020 resets
23	Deadman task not running fault	68020 resets
24	Undefined or invalid 68020 interrupt fault	68020 resets
25	68020 bus error	68020 resets
26	68020 address error	68020 resets
27	68020 illegal instruction	68020 resets
28	68020 privilege violation	68020 resets
29	68020 format error	68020 resets
30	68020 uninitialized device interrupt fault	68020 resets
31	68020 spurious interrupt	68020 resets
32	68020 divide by zero	68020 resets
33	Bad system NVRAM info record fault	fault is logged
34	General Application Fault	fault is logged
36	68020 keypad unit faults	fault is logged
37	68020 recorder unit faults	fault is logged
38	68020 modem driver fault	fault is logged
40	68020 memory manager error	68020 resets
41	68020 memory free fault	68020 resets
42	68020 memory allocation fault	68020 resets
43	FOS Module Failure	fault is logged
44	DSP Hardware Fault	fault is logged
45	System failure	System shutdown

The following is a list of IABP (Main Board 6809 CPU) fault codes.

FAULT INDEX	DESCRIPTION	SYSTEM RESPONSE
47	IABP stack probe fault	fault is logged
48	Task fault	fault is logged
49	ROM write fault	IABP shutdown - System failure
50	Software interrupt fault	IABP shutdown - System failure
51	Software trap fault	IABP shutdown - System failure
52	IABP/COMM flip flop fault	IABP shutdown - System failure
53	Front End fault	IABP shutdown - System failure

FAULT INDEX	DESCRIPTION	SYSTEM RESPONSE
54	Prolonged inflation fail-safe	IABP shutdown - System failure
55	Monitor keypad fault	IABP shutdown - System failure
56	IABP dead man fault	IABP shutdown - System failure
57	Autofill failure	See Autofill failure codes
58	Bimba fill fault	Vol. Cyl. fill time > than 6 sec. (no failure)
59	Bimba empty fault	Vol. Cyl. empty time > than 6 sec. (no failure)
60	Trigger data fault	68020 to 6809 trigger data time-out
61	Excess drive pressure fault	Drive Pressure > 25 mmHg over ATM in standby
62	Purge cycle is taking too long	Fault is logged
63	Compressor motor over temperature	Fault is logged
64	Power Supply Fan Failure	Maintenance code #7 is displayed and fault is logged.
65	Pressure solenoid failure	IABP shutdown - System failure
66	Safety vent failure	IABP shutdown - System failure
67	Temperature sensor fails range test	Fault is logged

Autofill Failure Codes

These codes are logged in "Last Faults". When fault 57 (Autofill Failure) is displayed, then the last two or three digits indicate the specific failure mode. (i.e. 1 0, 6 0 or 16 0).

If the fault is preceded by a "C", or "E" (i.e. CE 0, EF 0), then the Autofill Failure was the result of a blood back detection from the shuttle pressure surveillance.

If the fault is preceded by a "4" (i.e. 4E 0 or 4F 0) then the Autofill failure was caused by a leak in the catheter or Autofill system.

If the fault is preceded by an "8" or a "9" (i.e. 82 0, 96 0), then the Autofill Failure was the result of blood detected optically.

The following Autofill Failure codes are produced when a failure is detected during the Autofill process and when not using a Sensor IAB (fiber optic).

FAULT INDEX	FAILURE DESCRIPTION	REMARKS
1 0	Helium volume cylinder did not empty (close S2) within 10 seconds at the beginning of Autofill.	No IAB connected, empty sensor (S2) failure or mis-positioned, no vacuum, pinched tubing to volume cylinder.
2 0	Initial IABP purge failure. (Could not empty Safety Disk.)	Unable to purge at beginning of Autofill. No IAB connected, leak in IAB circuit, extreme water buildup, clogged purge line filter, K3/K5 failure.
3 0	Helium volume cylinder did not move (open S2 empty sensor) within 5 seconds.	Tank closed, no helium, restricted tubing. Volume cylinder stuck, no output from helium regulator.
4 0	Software error or blood detected during delay state.	Software error. Did not advance to the next state.

FAULT INDEX	FAILURE DESCRIPTION	REMARKS
5 0	Helium volume cylinder did not reach full sensor (close S1) within 10 seconds.	Low helium pressure. Full sensor position, volume cylinder sluggish, restricted tubing.
6 0	Final IABP purge failure - Could not reach 150 mmHg absolute pressure within 14 seconds.	Insufficient vacuum, vacuum leak, leak in IAB circuit, extreme water buildup, clogged purge line filter, K3/K5 failure.
7 0	IAB tubing and Safety Disk did not fill with helium from volume cylinder within 10 seconds.	Wrong or no catheter extender, sensor position, volume cylinder sticking or sluggish.
8 0	Software error or blood detected during delay state.	Software error. Did not advance to the next state.
9 0	Transducer atmospheric calibration failure.	Transducers could not be zeroed at end of Autofill cycle. Check Shuttle, Drive and Atmospheric Transducers.
A 0	Software error or blood detected during delay state.	Software error. Did not advance to the next state.
B 0	Unexpected shuttle gas pressure rise detected during IAB purge cycle.	Possible leak in IAB circuit. Check for blood in system. Run Safety Disk Leak Test to check for leaks.
C 0	14 second IAB purge time-out at initial purge level, prior to Safety Vent test.	Slow purge. Leak in IAB circuit, extreme water buildup, clogged purge line filter, K3/K5 failure.
D 0	Failure to reach first surveillance purge level in 1 second, or 14 second IABP purge time-out.	Slow purge. Vacuum leak, leak in IAB circuit, extreme water buildup, clogged purge line filter, K3/K5 failure.
xE 0	Leak/blood detected after reaching first surveillance purge level.	Possible leak in IAB circuit. Check for blood in system. Run Safety Disk Leak Test to check for leaks.
xF 0	Leak/blood detected after reaching second surveillance purge level.	Possible leak in IAB circuit. Check for blood in system. Run Safety Disk Leak Test to check for leaks.

NOTE: x is a prefix code for leak or blood detect.

The following Autofill Failure codes are produced when a failure is detected during the Sensor IAB calibration.

FAULT INDEX	FAILURE DESCRIPTION	REMARKS
10 0	Software error	System did not advance to the next pneumatic state.
11 0	Software error	This code is no longer produced.
12 0	Software error	This code is no longer produced.
13 0	Drive pressure failed to reach vacuum level for dead volume calculation in 14 seconds.	Insufficient vacuum, vacuum leak.
14 0	Helium volume cylinder did not empty (close S2) within 10 seconds following a dead volume calculation.	Empty sensor (S2) failure or mis-positioned, pinched tubing to volume cylinder.
15 0	Helium volume cylinder did not empty (close S2) within 10 seconds following a dead volume calculation.	No IAB connected, empty sensor (S2) failure or mis-positioned, pinched tubing to volume cylinder. No vacuum.

FAULT INDEX	FAILURE DESCRIPTION	REMARKS
16 0	Shuttle pressure failed to reach initial purge level for dead volume calculation within 14 seconds.	Slow purge. Vacuum leak, leak in IAB circuit, extreme water buildup, clogged purge line filter, K3/K5 failure.
17 0	Helium volume cylinder did not empty (close S2) within 10 seconds following an abort of the dead volume calculation due to deep shuttle vacuum.	Previous autofill was aborted with a deep shuttle vacuum. Empty sensor (S2) failure or mis-positioned, pinched tubing to volume cylinder.
18 0	Dead volume calculation produced invalid value.	Check Shuttle, Drive and Atmospheric transducers. Safety disk port blocked.
19 0	Drive pressure failed to reach vacuum level prior to inflation for sensor calibration within 5 seconds.	Insufficient vacuum, vacuum leak.
1A 0	Shuttle pressure failed to reach target purge level in 10 seconds.	Slow purge. Vacuum leak, leak in IAB circuit, extreme water buildup, clogged purge line filter, K3/K5 failure.
1B 0	Helium volume cylinder did not empty (close S2) within 10 seconds following a sensor calibration cycle.	IAB disconnected, empty sensor (S2) failure, loss of vacuum.
1C 0	Autofill cycle automatically repeated at least 3 times without a pump cycle.	Incorrect catheter extender, check Atmospheric Transducer.
1D 0	Software error	This code is no longer produced.

Last Alarms

Press the **OPEN MENU** key again to display the last 20 alarms. This fault log can be cleared by pressing the **REF LINE** key twice.

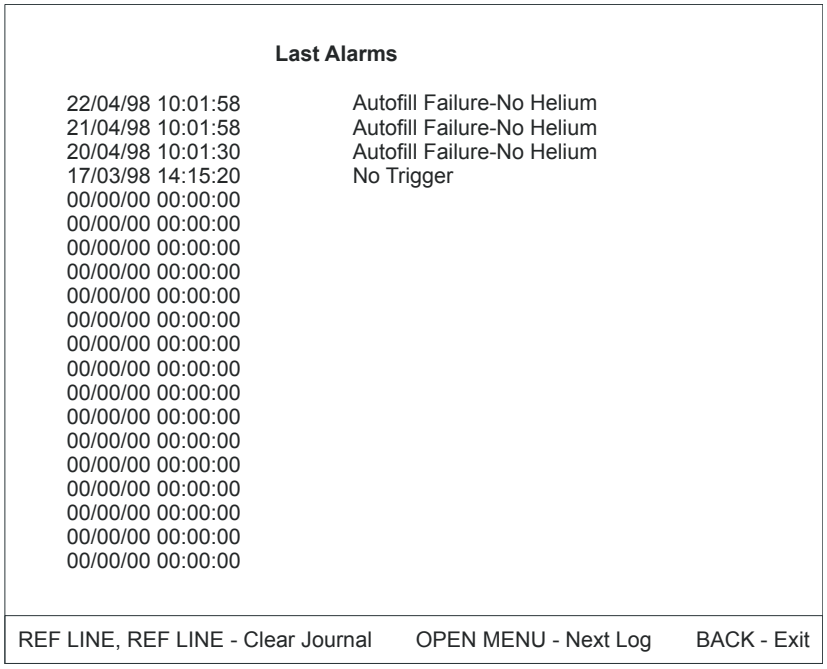


FIGURE 2-18 Last Alarms Log (Press **PRINT STRIP** to start the recorder)

Last Electrical Failures

Press the **OPEN MENU** key again to display the last 20 power up self-test failures. This fault log can be cleared by pressing the **REF LINE** key twice.

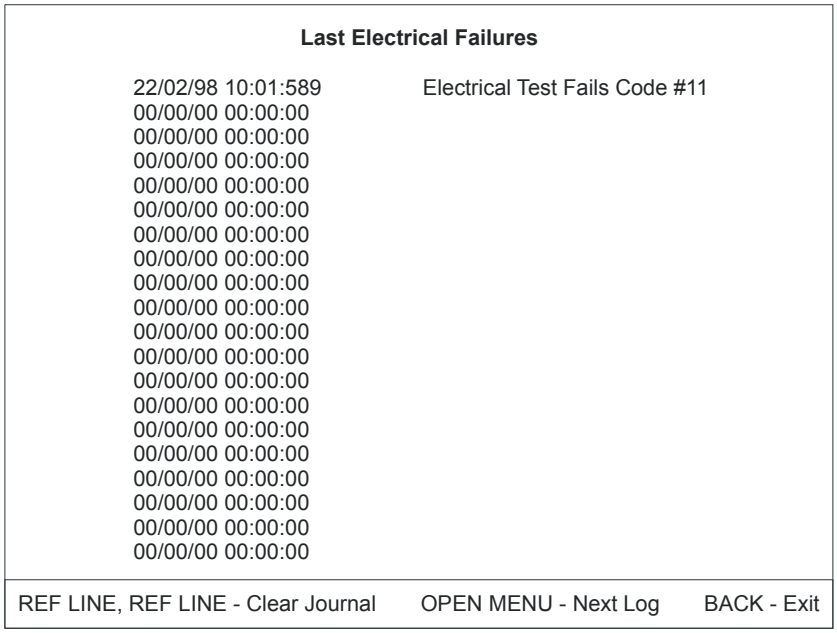


FIGURE 2-19 Last Electrical Failures Log (Press **PRINT STRIP** to start the recorder)

Last Triggers

Press the **OPEN MENU** key again to display the last 20 trigger modes. This fault log can be cleared by pressing the **REF LINE** key twice.

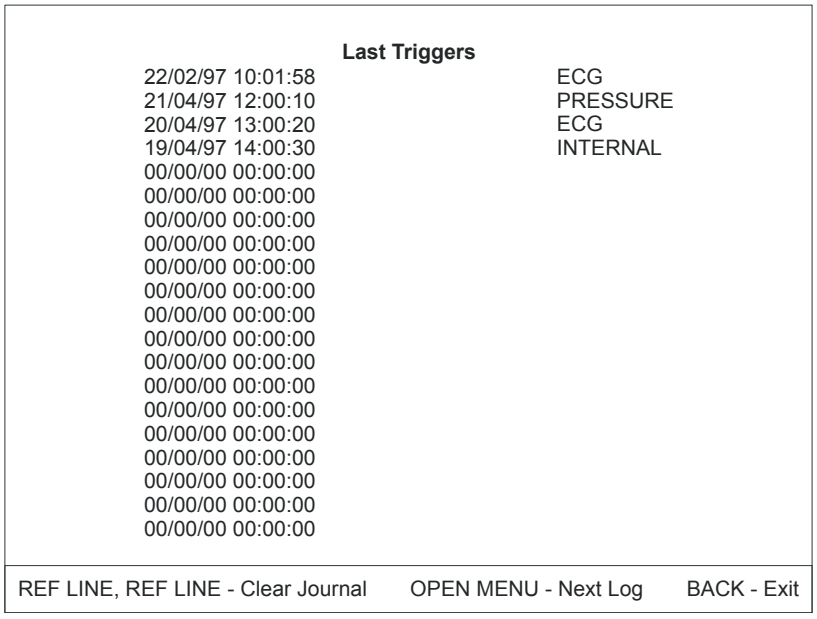


FIGURE 2-20 Last Trigger Log (Press **PRINT STRIP** to start the recorder)

2.8.3.8.2 Display Internal Statistics

This screen shows the following system information:

- Pump cycle count (number of times the IAB has been inflated)
- Accumulated assist time (time in hours:minutes that the system has been in ASSIST Mode)
- Battery statistics:
  - Last 3 start of discharge times
  - Last 3 end of discharge times
  - Last 3 full charge or top off times

This screen allows the internal statistics to be cleared by pressing the **REF LINE** key twice. This should only be done if the non-volatile RAM has been corrupted or the Main Board has been replaced.

2.8.3.8.3 Display Software Revision

Display Software Revisions for the **CS300**.

2.9 Pneumatic Instructions

2.9.1 Removal

Removing the Pneumatic Assembly - See "Theory of Operation" on page 1-1 for cable connector locations.

1. Remove the **IABP** from the cart (if applicable). Remove the Right Side panel (the side with the handle).
2. Loosen and remove the Top Cover.

NOTE: Carefully lift and remove the two (2) Screw Cover Tabs to access two (2) of the screws. Remember the screw above the helium tank is held by a nut via the saline pole bracket.

3. Remove the Front panel (Recorder) by removing four (4) screws and disconnecting the cable at the Recorder Interface PCB.
4. Open the E-panel door and disconnect the Test Connector cable (P/N 0012-00-0766), the ECG cable (P/N 0012-00-0976), and the Pressure cable (P/N 0012-00-0977).
5. Disconnect the cable between the Drive manifold and the Solenoid Driver PCB (P/N 0012-00-1104) at the floating connector near the solenoids.
6. Disconnect the two (2) cables that run from the Main PCB to JP1 and JP2 at the Solenoid Driver PCB (P/N 0012-00-1096-01, P/N 0012-00-1097-01). Disconnect the Bimba cables from JP7 at the Solenoid Driver PCB. Remove all of these cables from the cable clamp.
7. Disconnect the Drive Transducer cable from the Front End PCB (J5) and remove it from the cable clamps.

8. Disconnect the Pressure and Vacuum lines from the reservoir (cut tie-wraps).
9. Loosen the mounting hardware and slide the Purge Assembly (K3/K5) out. Disconnect the tubing at the reservoir from the Purge Assembly. Disconnect the black tubing to the Bimba via the 8 PSI regulator adjustment access hole (See FIGURE 2-21).
10. Remove the mounting hardware of the Pneumatic Assembly (3 screws at top and 3 screws at bottom - shown in FIGURE 2-21) and slide the assembly through the opening of the chassis at the Front panel.

NOTE: The Pneumatic Assembly includes the reservoir, the Bimba, the K6, K6A, K7, and K8 solenoids, and the 8 PSI regulator all mounted on a bracket.

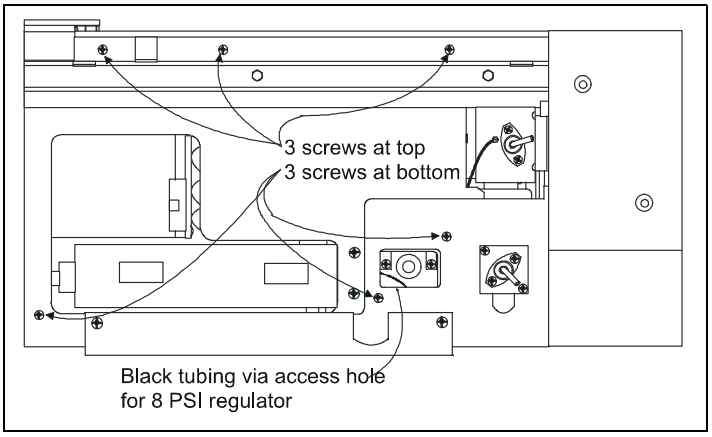


FIGURE 2-21 Tubing and Hardware Locations

2.9.2 Disassembly

Disassembly of the Pneumatic Assembly - considering that all of the sub-assemblies and single components are mounted to the reservoir, the following instructions are written for reservoir replacement.

1. Disconnect the K6A connector (2 black wire cable) from the Bimba cable connection.
2. Disconnect the K6A tubing from the Drive Assembly port.
3. Loosen and remove the four (4) screws that secure the reservoir bracket to the assembly bracket (four (4) shock mount screws that pass through the blue washers. Two of the screws may be difficult to remove due to the location of the foam. These can be removed once the Drive Assembly has been removed).
4. Remove the two (2) screws that secure the K6A solenoid to the reservoir and remove K6A.
5. Remove the two (2) screws that secure the 8 PSI regulator bracket to the reservoir. Lift the regulator and pull it away from the port in which the O-ring fitting is installed. The O-ring is covered with grease. DO NOT clean this grease off of the O-ring.
6. Loosen and remove the pressure relief valve from the port.
7. Remove the four (4) screws from the K6, K7, and K8 manifold (Drive Assembly). Carefully remove the assembly from the reservoir as there are two (2) O-rings under the manifold. If these O-rings should fall out of the pressure/vacuum ports, place them back into the ports, ensuring that dirt or debris does not collect on them.

2.9.3 Re-Assembly

Replacement Parts Required

P/N 0103-00-0158	Fitting, hose
P/N 0125-01-0001(2)	Tie-wrap (for re-installation of vacuum/pressure tubing)
P/N 0343-05-0001	Clamp, cable
P/N 0349-00-0301	Insulator, Drive Manifold
Loctite #242	Adhesive

1. Remove the four (4) blue washers from the reservoir bracket and place them in the same holes on the new, replacement reservoir bracket (if applicable).
2. Adhere the foam insulator (P/N 0349-00-0301) onto the new reservoir so that it surrounds the Drive Manifold mounting plate and does not block the blue grommets.
3. Install the new hose fitting (P/N 0103-00-0158) into the vacuum reservoir.
4. Re-install two (2) of the four (4) shock mount screws into the blue washers at the insulator end (the insulator should be able to hold the screws in place).
5. Verify that the two (2) O-rings are in the pressure/vacuum ports of the Drive manifold. Re-install the Drive Assembly using the same four (4) screws (#8-32 x 2.00"), applying one small drop of Loctite #242 on the screw threads.
6. Clean off the old teflon tape from the threads on the pressure relief valve. Re-apply new tape, ensuring that it is not placed too close to the open end of the valve. Re-install the pressure relief valve into the mounting block of the reservoir.
7. Re-install the 8 PSI regulator by reinserting the O-ring fitting into the mounting block (opposite the pressure relief valve) and reinstalling the two (2) screws (#6-32 x 1/4") into the regulator bracket.
8. Re-install the K6A solenoid.
9. Place the black 1/8" tubing from the K6A solenoid into the cable clamp (P/N 0343-05-0001) shown in FIGURE 2-22. Route it back to the port on the Drive manifold and connect it. Verify that the two (2) shock mount screws are still inserted into the blue washers.
10. Re-mount the reservoir bracket to the assembly bracket by inserting the two (2) remaining shock mount screws into the blue washers and then tightening all four (4) screws. Verify that the K6A tubing is not pinched!
11. Slide the pneumatic assembly into the chassis via the Front Panel opening. Re-connect all of the cables and tubing. Re-install the 6 screws that secure the pneumatic assembly to the chassis.

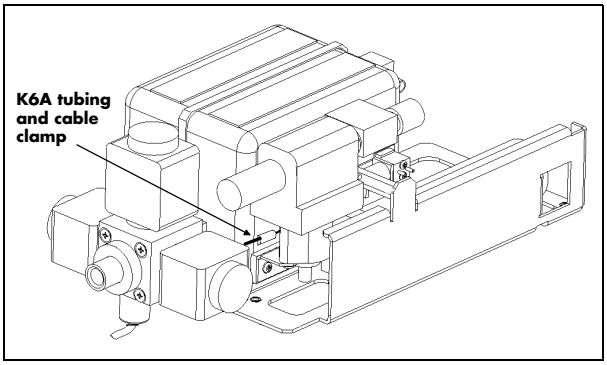


FIGURE 2-22 Cable Clamp Location

2.10 Helium Regulator Yoke Extension Removal

The helium regulator yoke extension and rear panel insert may be removed to provide for a more recessed helium bottle.

2.10.1 Pre-Removal Helium Leak Check

Prior to performing the yoke extension removal, check the helium system in accordance with section 4.4.15 of this manual.

2.10.2 Rear Panel Cover Removal

NOTE: Retain all screws for use in reassembly.

1. Remove the Helium Tank.
2. Remove the Right Side and Top Covers.
3. Remove and discard the Filler Panel (0380-00-0501).
4. Remove and discard the (2) standoffs (0361-00-0770-02) from the Rear Panel and the (1) standoff (0361-00-0770-01) at the top of the Rear Panel using a ½" nut driver.
5. Remove the Safety Disk and the Rear Panel.

2.10.3 Yoke Removal

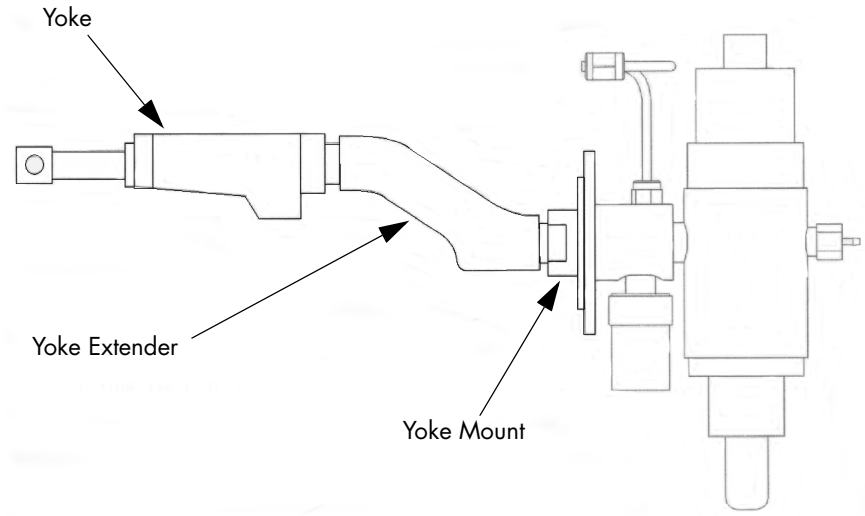


FIGURE 2-23 Helium Regulator Assembly

1. Remove the Yoke (0103-00-0404) from the Yoke Extender (0103-00-0538). Remove residual Teflon tape from the Yoke threads.
2. Remove the Yoke Extender from the Yoke Mount and discard the Yoke Extender.
3. While ensuring that no foreign objects enter the Yoke Mount, carefully clean its threads, working in a counter-clockwise direction to remove all residual thread tape and other residue.
4. Prepare the Yoke by applying new Teflon tape.

NOTE: Ensure that there is no tape on the 1st thread of the Yoke.

5. Install the Yoke while ensuring to align it so that the Helium Tank will fit vertically. (Hint: Check the alignment by connecting a Trainer and Helium Tank to the IABP.)
6. Recheck the helium system in accordance with section 4.4.15 of this manual. If a leak is detected, use a small amount of a soapy solution and apply to the connection of the Yoke. Look for small bubbles to build. Tighten the connection, or remove the Yoke, clean and re-tape as necessary.
7. Install the Rear Panel using (2) #8-32 x 1/2 screws (0212-12-0808) and (1) #8-32 x 0.625 screw (0212-12-0810).
8. Adhere the helium label, **He** (0334-00-2618) onto the Rear Panel, positioning it approximately halfway between the upper screw and the Yoke and centering it horizontally.
9. Install the Right Side and Top Covers.

3.0 *Replacement Parts*

3.1 Introduction

This section of the manual provides information that is necessary to identify the replacement parts and assemblies of the instrument.

3.2 Available Replacement Parts and Sub-Assemblies

The parts listings which follow are divided into two sections. The Isometric Drawings and the accompanying parts lists identify the available chassis mounted components.

3.2.1 Product Variations and Options

Product variations, due to differences for various line voltages, may require different components. These variations are reflected, where necessary, on the parts lists.

3.2.2 Exchange Program

Datascope offers an exchange policy for many of the printed circuit board assemblies. This program may provide the most expedient method of servicing the equipment. A standard charge for this service is made. Contact the Datascope Service Department for details concerning this exchange program.

Many circuit boards make extensive use of multi-layer and surface mount technology. Individual component replacement is not recommended on these boards. Board exchange or replacement is the most efficient method of repair for these types of assemblies. Component level repair is not recommended.

Circuit boards, returned as parts of the exchange program, that show evidence of improper repair techniques and are damaged in the process are not considered for exchange. Damaged boards will be invoiced at full value and no exchange credit will be applied.

3.2.3 Replacement Parts Pricing Information

Current parts prices and exchange charges can be determined by contacting the Datascope Customer Support Department.

3.2.4 Ordering Information

Replacement parts and assemblies are available from Datascope Corp., and in Europe from Datascope B.V. Please follow these guidelines when ordering replacement items for the instrument:

1. Include the Model and Serial Number of the instrument.
2. Include the Datascope Part Number exactly as it appears in the Parts List under the column, "Part Number."
3. Include a description of the item.

EXAMPLE ORDERS:

(1) ea. P/N 0334-00-2611-01
Label, Fuse Replacement, Serial No. XXXX
(2) ea. P/N 0213-07-0404
Screw, Self Tap, #4 x 0.25", Serial No. XXXX

NOTE: **Datascope Corp. maintains a policy of continuous development for product improvement and reserves the right to change materials, specifications, and prices without notice.**

3.2.5 Abbreviations

The following abbreviations may appear in the parts listings which follow and throughout the manual.

ABBREVIATION	TERM	ABBREVIATION	TERM
A/D	Analog to Digital	MYLR	Mylar
AMP	Amplifier	NTWK	Network
BUF	Buffer	OP	Operational
CAP	Capacitor	PB	Push Button
CC	Carbon Composition	PIA	Peripheral Interface Adaptor
CER	Ceramic	POT	Potentiometer
CERM	Ceramic	PRESS	Pressure
CNTR	Counter	PWR	Power
CONN	Connector	RAM	Random Access Memory
CONT	Controller	REC	Receiver
CONV	Converter	RECT	Rectangular
CPU	Central Processing Unit	REG	Regulated RES Resistor
DCDR	Decoder	STG	Stage
DIFF	Differential	STK	Stacked
DIA	Diastolic	SUP	Supply
DIO	Diode	SW	Switch
D/A	Digital to Analog	SYST	Systolic
ELEC	Electrolytic	TANT	Tantalum
EPROM	Erasable Programmable Read Only Memory	TRANS	Transistor
FOS	Fiber Optic Sensor	TRANSIS	Transistor
FXD	Fixed	VAR	Variable
I.C.	Integrated Circuit	VIA	Versatile Interface Adapter
INT. CKT.	Integrated Circuit	XDCR	Transducer
KYBD	Keyboard	XFMR	Transformer
LED	Light Emitting Diode	XSTL	Crystal
MF	Metal Film	XSTR	Transistor
MONO	Monostable		

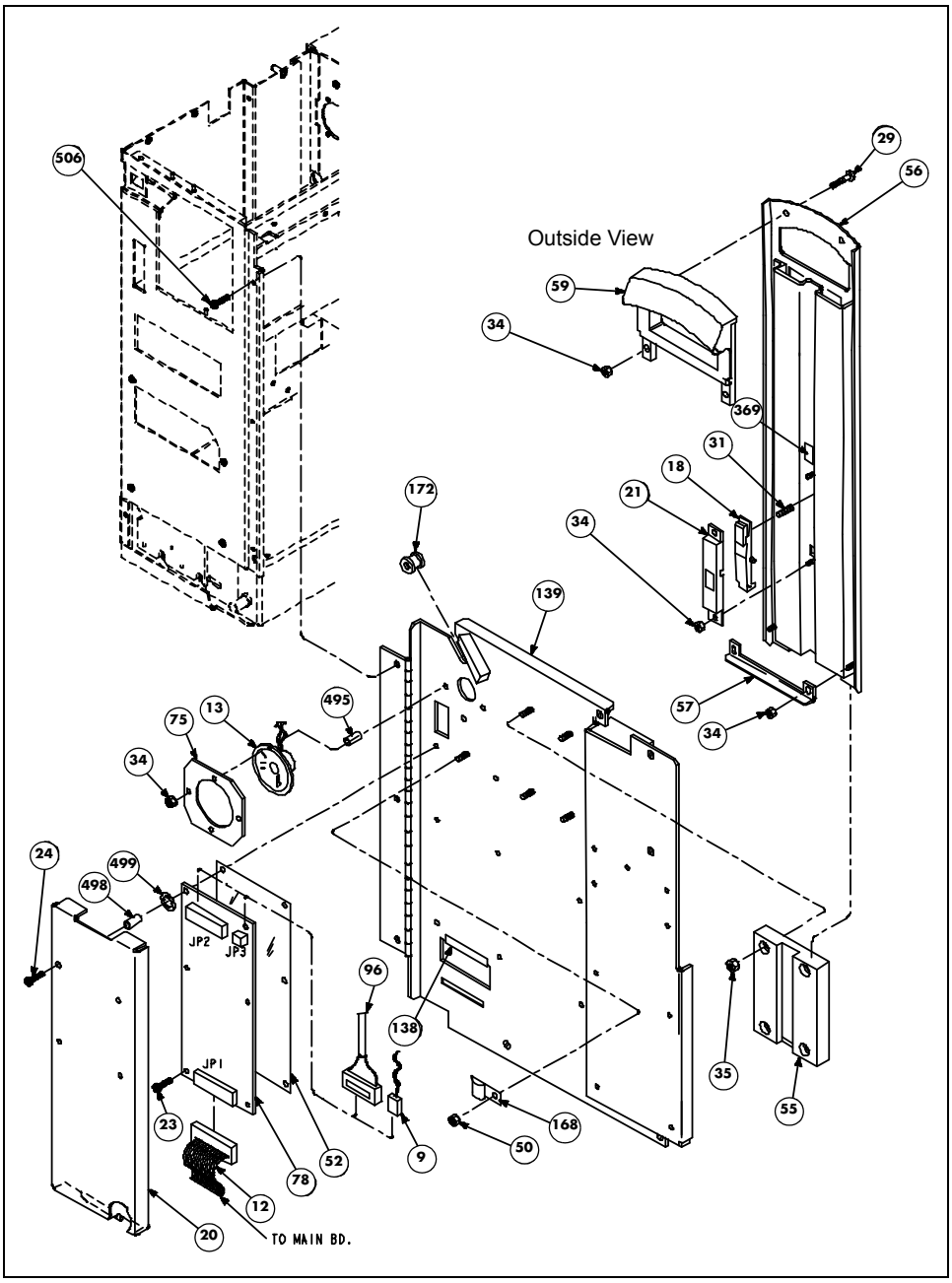


FIGURE 3-1 Isometric Drawing, Chassis, Left Door (Outside View)

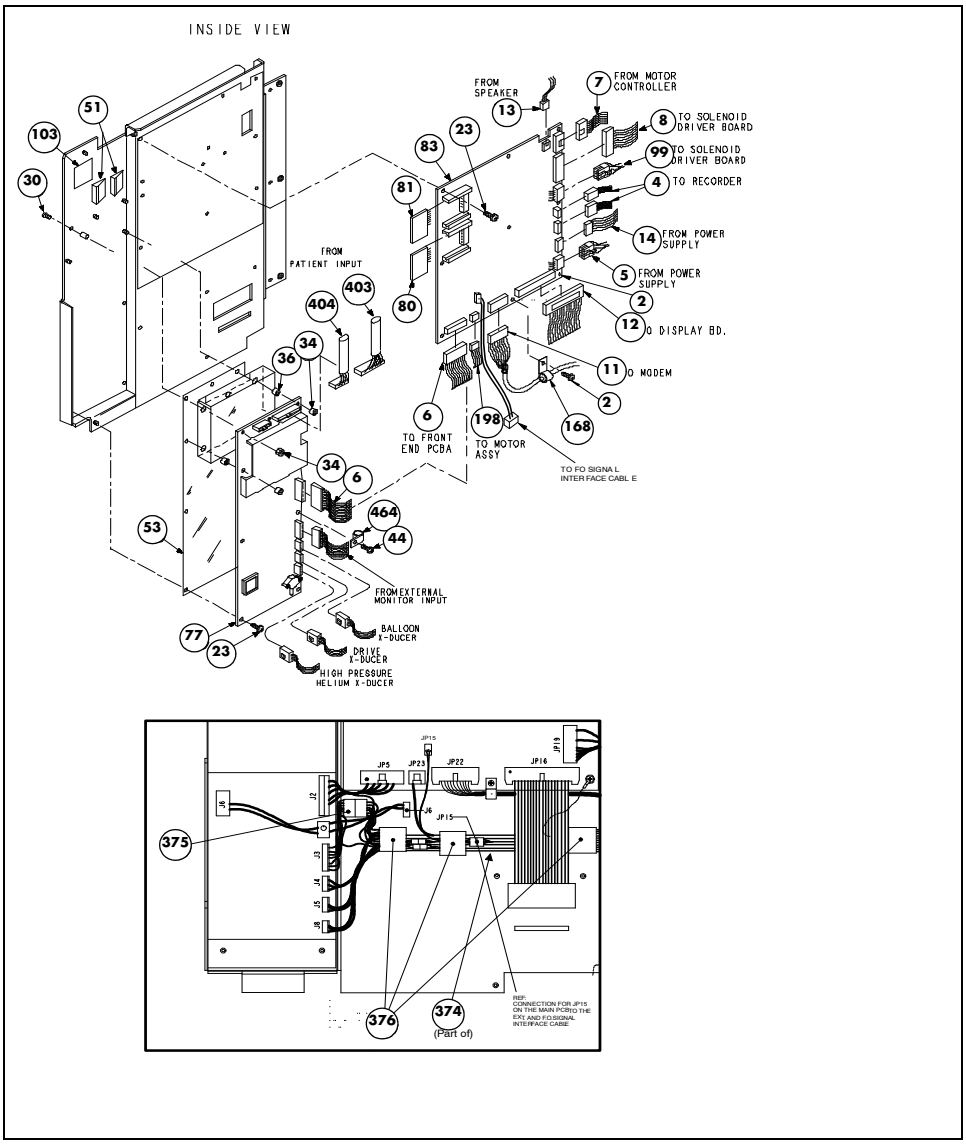


FIGURE 3-2 Isometric Drawing, Chassis, Left Door (Inside View)

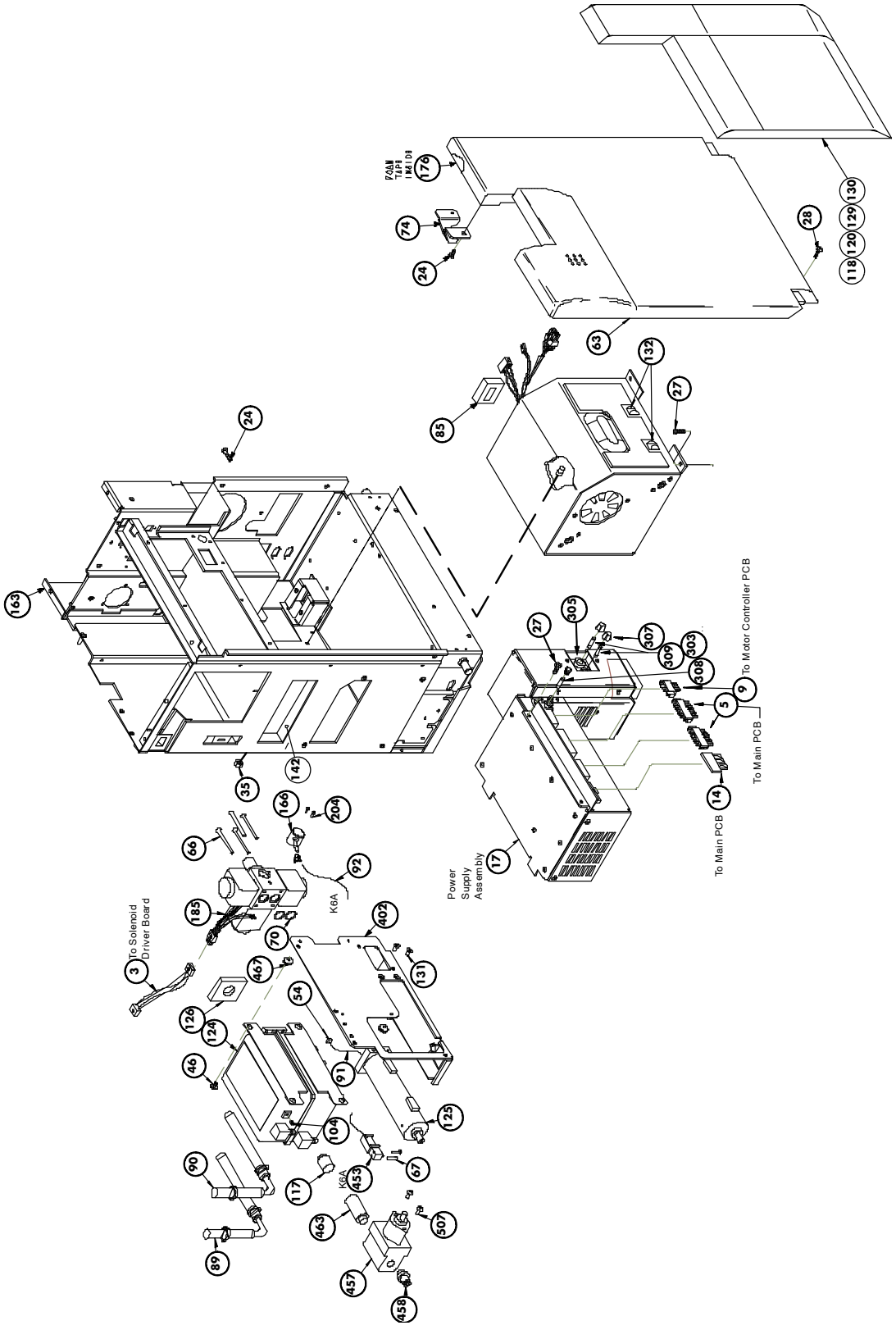


FIGURE 3-3 Isometric Drawing, Chassis, Left Side, Bottom

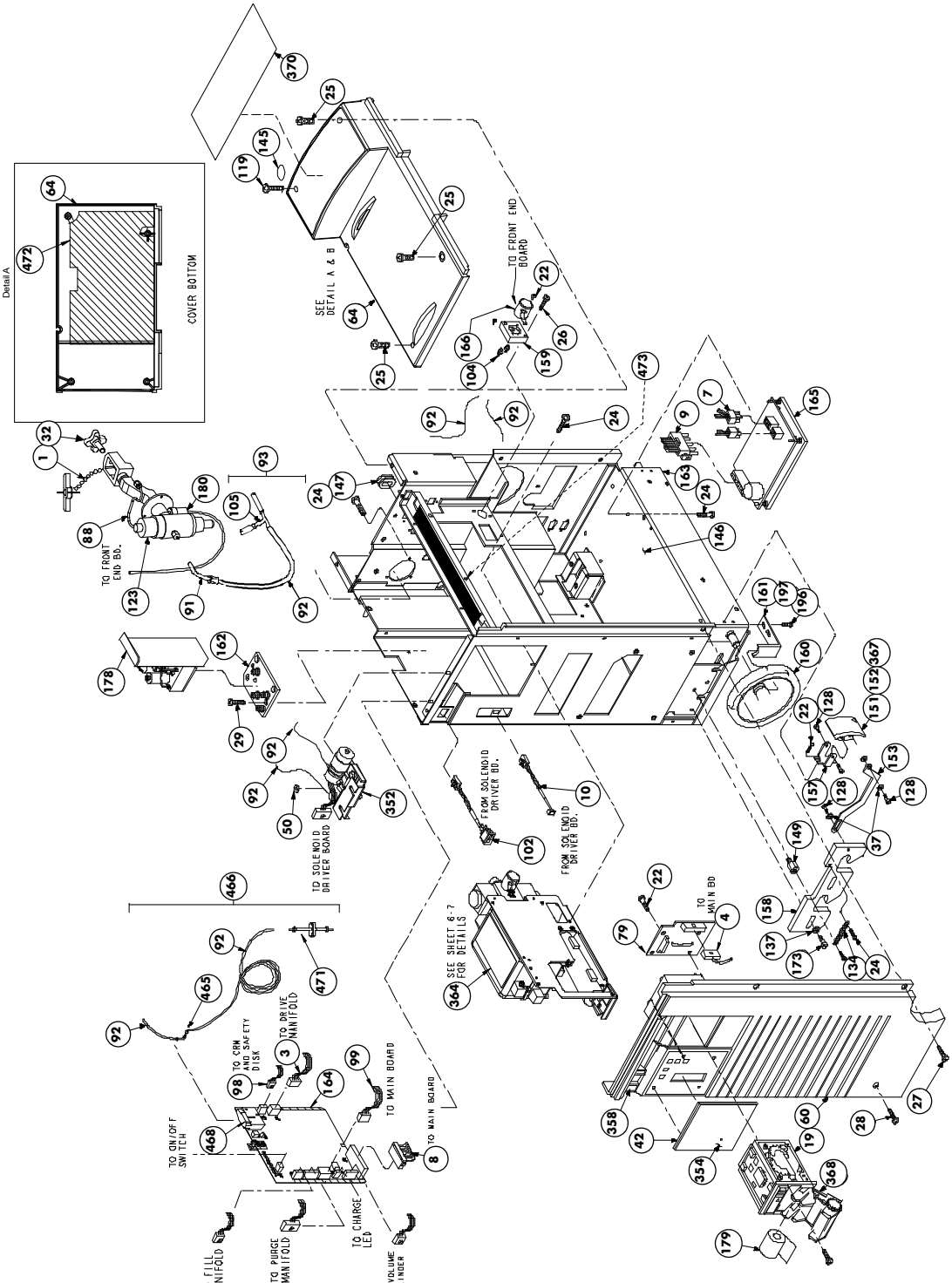


FIGURE 3-4 Isometric Drawing, Chassis, Left Side, Top

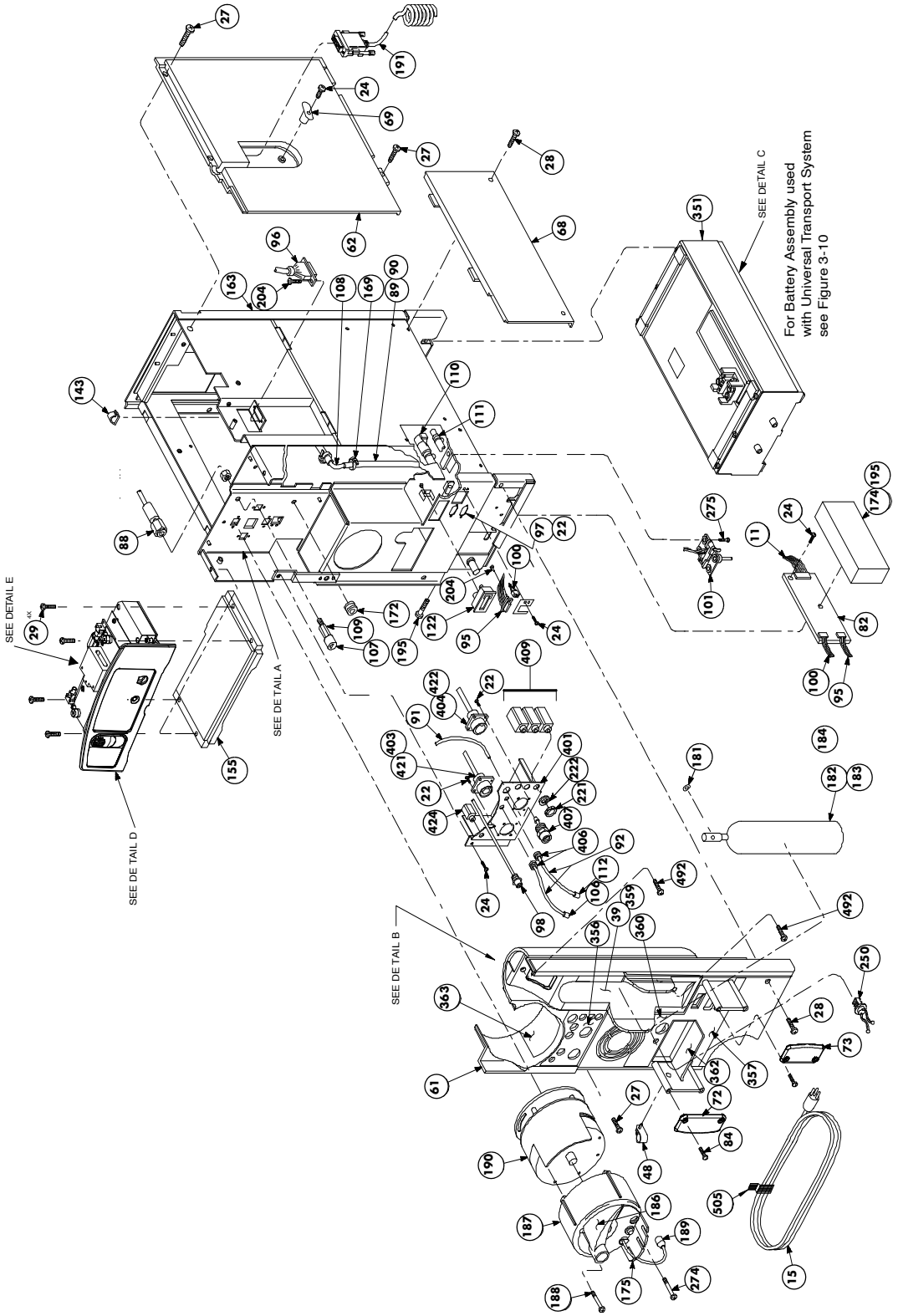


FIGURE 3-5 Isometric Drawing, Chassis, Right Side

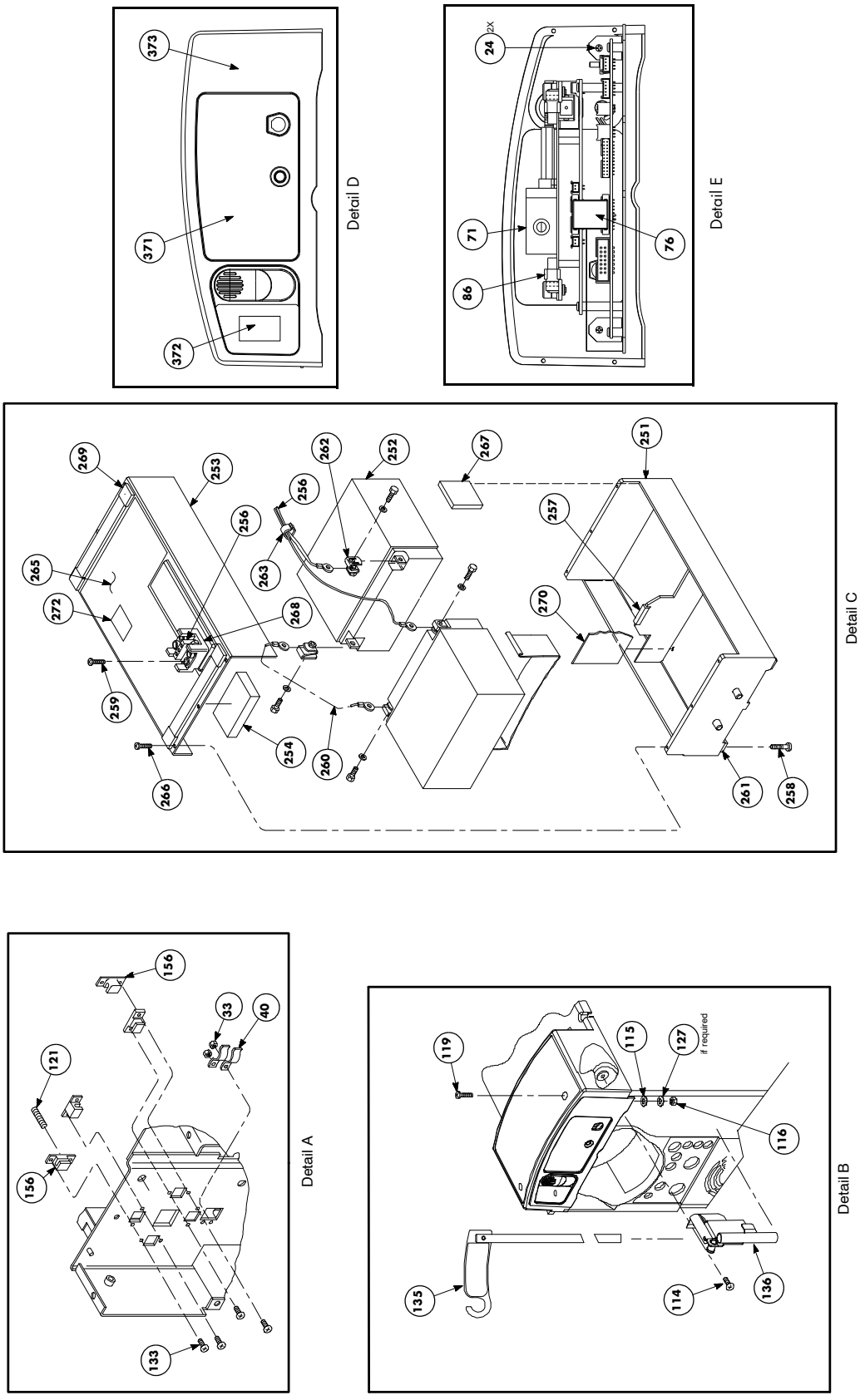


FIGURE 3-6 Isometric Drawing, Chassis, Right Side (Details)

3.3 Isometric Drawing and Parts Lists

3.3.1 Chassis

FIG. NO.	DESCRIPTION	PART NUMBER
1	Helium Cylinder Valve Knob	0366-00-0092
2	Pan Head Screw, #6-32 x 0.312″	0212-12-0605
3	Cable, Drive Assembly to Solenoid Driver Board	0012-00-1104
4	Cable, Main PCB to Recorder PCB	0012-00-1061
5	Cable, Power Supply to Main PCB	0012-00-1060
6	Cable, Front End PCB to Main PCB with Sync	0012-00-1537
7	Cable, Main PCB to Motor Cntrl PCB	0012-00-0759-02
8	Cable, Solenoid Driver PCB to Main PCB	0012-00-1097-01
9	Cable, Power Supply to Motor/Display PCB	0012-00-1056
10	Cable, LED Charge	0012-00-1062
11	Cable, Main PCB to Modem PCB	0012-00-1196-01
12	Cable, Main PCB to Display PCB	0012-00-0888
13	Speaker and Cable	0012-00-0874-02
14	Cable, Power Supply to Main PCB	0012-00-0875-02
15	Line Cord, 110V AC	0012-00-0886-01
	Line Cord, 220V AC	0012-00-0886-02
	Line Cord, 220V AC (Chinese)	0012-00-0886-03
17	Power Supply Assembly	0014-00-0033-05
18	Slide Latch	0105-00-0087
19	Recorder, AR-42	0161-00-0022
20	Cover, Display PCB	0198-00-0004
21	Cap Latch	0200-00-0292
22	Pan Head Screw, #4-40 x 0.25″	0212-12-0404
23	Pan Head Screw, #6-32 x 0.187″	0212-12-0603
24	Pan Head Screw, #6-32 x 0.25″	0212-12-0604
25	Screw, Self Sealing, Pan HD #6-32 x 0.625″	0212-27-0610-01
26	Pan Head Screw, #6-32 x 0.625″	0212-12-0610
27	Pan Head Screw, #8-32 x 0.25″	0212-12-0804
28	Pan Head Screw, #8-32 x 0.375″	0212-12-0806
29	Flat Head Screw, #6-32 x 0.25″	0212-17-0604
31	Compression Spring	0214-00-0214
32	Knob, Clamping	0366-00-0104
33	Shakeproof Nut #4-40	0220-06-0004
34	Shakeproof Nut #6-32	0220-06-0006
35	Nut, Stop #8-32	0220-06-0008
36	Standoff, hex, #6-32	0361-04-0068
37	Nylon Washer	0210-07-0002

* *See "Chassis International Parts List" on page 3-17*

NS Not Shown

FIG. NO.	DESCRIPTION	PART NUMBER
39	Panel, Insert	0380-00-0501
42	Plate, Spacer	0386-00-0233
44	Screw, #6-32 x 0.375"	0217-02-0002
46	Screw, Shock Mount	0217-00-0013
48	Clamp	0343-00-0073
50	Nut, Stop, #6	0220-07-0006
51	Cable Clamp	0343-00-0005
52	Insulator, Display PCB	0349-00-0231
54	Fitting, Volume Cylinder	0103-00-0341
55	Guide	0351-00-0088
56	Slide Panel	0351-00-0070
57	Handle Guide Stop	0351-00-0076
59	Pullout Handle	0367-00-0078
60	Front Panel	0380-00-0436
61	Rear Panel	0380-00-0435
62	Left Side Panel	0380-00-0434
63	Right Side Panel	0380-00-0437
64	Top Panel	0380-00-0497
66	Screw, #8-32 x 2.00"	0212-12-0832
67	Screw, #4-40 x 0.625"	0212-12-0410
68	Access Panel	0380-00-0431
69	Cord Retainer	0380-00-0430
70	O-Ring	0354-00-0066
71	Assembly, Fiber Optic	0997-00-1161
72	Left Cord Wrap Plate	0380-00-0453-01
73	Right Cord Wrap Plate	0380-00-0453-02
74	Hook Bracket	0406-00-0592
75	Plate, Speaker Mtg.	0386-00-0219
76	Cable, FO Interface	0012-00-1536
77	Front End PCB	0670-00-0668
78	Display PCB	0670-00-0640
79	Recorder Interconnect PCB	0670-00-0647
80	Datasette, DSS	0670-00-0787
81	Datasette, IABP	0670-00-0786
82	Modem PCB	0670-00-0763
83	Main PCB	0670-00-1152 0670-00-0788
84	Shoulder Screw, #6-32	0217-00-0012
85	Foam Gasket	0354-00-0045
86	Kit, FOS Lamp Replacement (2 lamps)	0040-00-0437
88	High Pressure Helium Hose	0009-00-0002

* *See "Chassis International Parts List" on page 3-17*

NS Not Shown

FIG. NO.	DESCRIPTION	PART NUMBER
89	Vacuum Hose Assembly V7, V8	0004-00-0062
90	Pressure Hose Assembly P5, P6	0004-00-0063
91	Tubing, 1/16" ID Santoprene	0004-00-0052
92	Tubing, 1/16" ID Polyurethane	0008-08-0001
93	Assembly, Helium Tube	0008-00-0311
95	Cable, Modem PCB to Rear Panel (RS-232)	0012-00-0761-02
96	Cable, Display PCB to Monitor Module	0012-00-1058
97	Front End PCB to Rear Panel Test Conn	0012-00-0766
98	Cable, Solenoid Driver PCB to CRM	0012-00-0767
99	Cable, Main PCB to Solenoid Driver PCB	0012-00-1096-01
100	Cable, Modem PCB to Rear Panel (Modem)	0012-00-0784-02
101	Cable, Battery Assembly to Power Supply	0012-00-0785
102	Cable, On/Off Switch	0012-00-0834
103	Label, Cable Routing	0334-00-1352
104	Hose Fitting (1/4")	0103-00-0484
104	Hose Fitting (5/16")	0103-00-0642
105	Tee Fitting	0103-00-0202
106	Male Luer Fitting	0103-00-0398-01
107	Pressure Gauge	0103-00-0418
109	Pneumatic Fitting	0103-00-0455
110	Tubing Assembly Vacuum V1 - V6	0004-00-0058
111	Tubing Assembly Pressure P1 - P4	0004-00-0055
112	Pneumatic Coupling	0103-00-0382-02
114	Screw, #8-32 x 5/8" Pan SS	0212-12-0810
115	Washer #6, External Tooth	0210-04-0006
116	Nut, #6-32 Cap	0220-10-0600
117	9 PSI Relief Valve	0103-01-0001
118	Doppler Assembly	0154-01-0001
119	Screw, Self Sealing, Pan HD #6-32 x 1-1/16"	0212-27-0617-01
120	Storage Bag without Doppler or Doppler Tether	0997-01-0532
121	Ball Plunger	0105-07-0003
122	Timer	0118-00-0018
123	Helium Regulator Assembly	0119-00-0208
124	Pneumatic Reservoir	0202-00-0127
125	Volume Cylinder	0202-00-0133
126	Insulator Foam	0349-00-0301
127	Washer, Flat #6	0221-00-0006
128	Shoulder Screw, #4-40 x 0.125"	0212-00-0097
129	Tether Assembly	0997-00-0406
130*	Label, Tether Release (English)	0334-00-2608-01
131	Flat Head Screw, #10-32 x 0.375"	0212-22-1006

* *See "Chassis International Parts List" on page 3-17*

NS Not Shown

FIG. NO.	DESCRIPTION	PART NUMBER
132	Cable Clamp	0343-05-0002
133	Flat Head Screw, #4-40 x 0.3125"	0213-07-0405
134	Spring	0214-00-0218
135	IV Pole	0436-00-0199
136	Brkt., Pole Mounting	0406-00-0742
137	Flat Washer	0221-00-0122
143	Cable Clamp	0343-05-0001
145	Label, Screw Cover	0334-00-1666
149	Standoff	0361-27-0250
151	Left Battery Release Lever	0367-00-0104-01
152	Right Battery Release Lever	0367-00-0104-02
153	Link	0376-00-0008
155	Plate	0386-00-0304
156	Guide Block	0391-00-0087
157	Lever Mounting Block	0391-00-0067
158	Latch Block	0391-00-0084
159	Transducer Mounting Block	0391-00-0077
160	Wheel	0401-00-0043
161	Wheel Bracket	0406-00-0600
162	Fill Manifold Bracket	0406-00-0613
163	Chassis	0441-00-0100
164	Solenoid Driver PCB	0670-00-0639
165	Motor Control PCB	0671-00-0004
166	Pressure Transducer	0682-00-0076-01
168	"P" Clamp	0343-10-0002
169	Tie Wrap	0125-01-0001
172	Grommet	0348-01-0012
173	Shoulder screw, #8-32 x 0.3125"	0212-00-0098
174	Modem Cover	0441-00-0094
175	CRM Guard	0380-00-0284
176	Gasket	0354-00-0046
178	Fill Assembly	0104-00-0023
179	Recorder Paper (10 rolls)	0683-00-0422-02
180	High Pressure Transducer	0682-00-0079-01
181	Washer, He cylinder	0348-00-0185
182	Refillable Helium Tank (Qty. 1)	0075-00-0024-01
182	Refillable Helium Tank (Qty. 3)	0075-00-0024-03
182	Refillable Helium Tank (Qty. 3) (German Units Only)	0075-02-0002-03
182	Refillable Helium Tank (Qty. 3) (U.K. and French Units Only)	0075-02-0001-03
183	Disposable Helium Tank	0202-00-0104

* *See "Chassis International Parts List" on page 3-17*

NS Not Shown

FIG. NO.	DESCRIPTION	PART NUMBER
185	Drive Assembly	0104-00-0018
186	Catheter Strain Relief	0358-00-0062
187*	Condensate Removal Module (English)	0997-00-0986-01
188	Pan Head Screw, #10-32 x 1.625"	0216-06-1026
189	Cable, CRM to Rear Panel	0012-00-0745
190*	Safety Disk (English)	0997-00-0985-01
191	Coiled Cable	0012-00-1422
195	Pan Head Screw, #4-40 x 1.125"	0212-12-0418
196	Pan Head Screw, #6-32 x 0.5"	0212-12-0608
197	Flat Washer	0221-01-0001
198	Cable, Thermal Switch	0012-00-0893-02
204	Pan Head Screw, #4-40 x 0.187"	0212-12-0403
250	Cable Clamp (press fit)	0343-13-0250
251	Battery Pack Chassis	0441-00-0073
252	Battery	0146-00-0039
253	Battery Pack Cover	0441-00-0074
254	Cushion	0349-00-0196
256	Cable, Battery to Connector	0012-00-0746
257	Channel Extrusion	0252-01-4181
258	Flat Head Screw, #4-40 x 0.25"	0212-17-0404
259	Pan Head Screw, #6-32 x 1.00"	0212-12-0616
260	Fusible Link	0011-00-0015
261	Foot	0348-00-0163
262	Terminal Nut #10-32	0220-00-0082
263	Cable Clamp	0343-05-0001
265*	Label, Battery Docking (English)	0334-00-1415-01
266	Pan Head Screw, #4-40 x 0.25"	0212-12-0404
267	Foam Pad	0685-00-0063
268	Connector Mounting Block	0380-00-0243
269	Handle	0367-00-0009
270	Insulator	0349-00-0225
272	3x3" Mylar Insulator	0349-00-0198
274	Screw #10-32 x 2.875" Pan Hd.	0216-02-1046
275	Screw, #6-32 x 0.5" Pan Hd.	0212-12-0608
305	Fan	0119-00-0152
307	DC Input Fuse, 30A	0159-00-0035
308	Bulk Fuse, 10A	0159-00-0036
309	AC Fuse, 10A	0159-00-0036
351	Battery Assembly	0146-00-0047-01
352	Purge Manifold	0104-00-0026
354*	Overlay, Charge Indicator	0330-00-0055-01

* *See "Chassis International Parts List" on page 3-17*

NS Not Shown

FIG. NO.	DESCRIPTION	PART NUMBER
356*	Rear Panel I/O Label	0334-00-2602-01
357*	Lower AC Label	0334-00-1634-01
358*	On/Off Label	0334-00-2612-01
359	Helium Label	0334-00-2618
360*	Upper AC Label	0334-00-2603-01
362*	Fuse Replacement Label	0334-00-2611-01
363*	Warning Label	0334-00-1121
367*	Battery Pack Release Label	0334-00-1736-01
368*	Recorder Label	0334-00-1174
369*	Handle Release Label	0334-00-1158
370*	Quick Reference Guide Label	0334-00-1635-01
371*	Label, LLBP Out	0334-00-1631-01
372*	Label, Fiber Interface	0334-00-1632-01
373	Assembly, FO Connector Panel	0997-00-0527
374	Cable, Ext and FO Signal Interface	0012-00-1539
375	Cable, High Level BP Interface	0012-00-1538
376	Clamp	0343-05-0003
401	CSD Bracket I/O	0406-00-0675
402	Bracket, Pneumatic	0441-00-0102
403	ECG Cable Assembly	0012-00-0976
404	Pressure Cable Assembly	0012-00-0977
406	Grommet	0348-12-0001
407	Manual Fill Valve	0103-00-0365
409	Cable Assembly, External I/O	0012-00-0765
453	K6A, Vent Valve	0119-00-0170
457	8 PSI Regulator	0103-00-0351
458	Quick Connect Coupling	0103-00-0458
463	Muffler	0103-00-0065
464	Cable Clamp	0125-00-0018
465	Glass Tubing	0008-00-0309
466	Fill Tubing Assembly (Glass Tubing, Filter and Tubing 1/16" ID Polyurethane)	0008-00-0312
467	Shock Mount	0348-09-0001
468	Plug, Blood Back Sensor	0380-00-0174
469	Mylar Insulator	0349-00-0198
471	Tubing Assembly, Filter	0008-00-0331
472	Insulator, Top Cover	0349-00-0348
492	Pan Head Screw	0212-12-0808
495	Standoff	0361-27-1000
498	Standoff	0361-27-0375
499	Star Washer	0210-09-0006

* *See "Chassis International Parts List" on page 3-17*

NS Not Shown

FIG. NO.	DESCRIPTION	PART NUMBER
505	Line Cord Wrap	0125-00-0020
506	Screw, SS flat head, #6-32 x 0.31 Lg x 100°	0212-17-0605
507	Screw, #10-32 x 0.31 Lg, pan head	0216-02-1005
NS	Insulator, lower front end PCB	0349-00-0244

* *See "Chassis International Parts List" on page 3-17*
NS Not Shown

3.3.2 Chassis International Parts List

FIG NO.	DESCRIPTION	SPANISH PART NUMBER	GERMAN PART NUMBER	FRENCH PART NUMBER	ITALIAN PART NUMBER
130	Label, Tether Release	0334-00-2608-05	0334-00-2608-03	0334-00-2608-04	0334-00-2608-07
187	Condensate Removal Module	0997-00-0986-05	0997-00-0986-03	0997-00-0986-04	0997-00-0986-07
190	Safety Disk	0997-00-0985-05	0997-00-0985-03	0997-00-0985-04	0997-00-0985-07
265	Label, Battery Docking	0334-00-1415-04	0334-00-1415-02	0334-00-1415-03	0334-00-1415-06
354	Overlay Charge Indicator	0330-00-0055-01	0330-00-0055-01	0330-00-0055-01	0330-00-0055-01
356	Rear Panel I/O Label	0334-00-2602-05	0334-00-2602-03	0334-00-2602-04	0334-00-2602-07
357	Lower AC Label	0334-00-1634-05	0334-00-1634-03	0334-00-1634-04	0334-00-1634-07
358	On/Off Label	0334-00-2612-05	0334-00-2612-03	0334-00-2612-04	0334-00-2612-07
360	Upper AC Label	0334-00-2603-05	0334-00-2603-03	0334-00-2603-04	0334-00-2603-07
362	Fuse Replacement Label	0334-00-2611-05	0334-00-2611-03	0334-00-2611-04	0334-00-2611-07
363	Warning Label	0334-00-1242-03	0334-00-1242-01	0334-00-1242-02	0334-00-1242-05
367	Battery Pack Release Label	0334-00-1736-05	0334-00-1736-03	0334-00-1736-04	0334-00-1736-07
368	Recorder Label	0334-00-1252-03	0334-00-1252-01	0334-00-1252-02	0334-00-1252-04
369	Handle Release Label	0334-00-1251-03	0334-00-1251-01	0334-00-1251-02	0334-00-1251-05
370	Quick Reference Guide Label	0334-00-1635-05	0334-00-1635-03	0334-00-1635-04	0334-00-1635-07
371	LLBP Out Label	0334-00-1631-05	0334-00-1631-03	0334-00-1631-04	0334-00-1631-07
372	Fiber Interface Label	0334-00-1632-05	0334-00-1632-03	0334-00-1632-04	0334-00-1632-07

FIG NO.	DESCRIPTION	PORTUGUESE PART NUMBER	SWEDISH PART NUMBER	JAPANESE PART NUMBER	CHINESE PART NUMBER
130	Label, Tether Release	0334-00-2608-08	0334-00-2608-09	0334-00-2608-06	0334-00-2608-15
187	Condensate Removal Module	0997-00-0986-08	0997-00-0986-09	0997-00-0986-06	0997-00-0986-15
190	Safety Disk	0997-00-0985-08	0997-00-0985-09	0997-00-0985-06	0997-00-0985-15
265	Label, Battery Docking	0334-00-1415-07	0334-00-1415-08	0334-00-1415-05	0334-00-1415-15
354	Overlay Charge Indicator	0330-00-0055-01	0330-00-0055-01	0330-00-0055-06	0330-00-0055-01
356	Rear Panel I/O Label	0334-00-2602-08	0334-00-2602-09	0334-00-2602-06	0334-00-2602-15
357	Lower AC Label	0334-00-1634-08	0334-00-1634-09	0334-00-1634-06	0334-00-1634-15
358	On/Off Label	0334-00–2612-08	0334-00-2612-09	0334-00-2612-01	0334-00-2612-15
360	Upper AC Label	0334-00-2603-08	0334-00-2603-09	0334-00-2603-06	0334-00-2603-15
362	Fuse Replacement Label	0334-00-2611-08	0334-00-2611-09	0334-00-2611-06	0334-00-2611-15
363	Warning Label	0334-00-1242-06	0334-00-1242-07	0334-00-1242-04	0334-00-1242-15
367	Battery Pack Release Label	0334-00-1736-08	0334-00-1736-09	0334-00-1736-06	0334-00-1736-15
368	Recorder Label	0334-00-1252-05	0334-00-1252-07	0334-00-1252-06	0334-00-1174
369	Handle Release Label	0334-00-1251-06	0334-00-1251-07	0334-00-1251-04	0334-00-1251-15
370	Quick Reference Guide Label	0334-00-1635-08	0334-00-1635-09	0334-00-1635-06	0334-00-1635-15
371	LLBP Out Label	0334-00-1631-08	0334-00-1631-09	0334-00-1631-06	0334-00-1631-15
372	Fiber Interface Label	0334-00-1632-08	0334-00-1632-09	0334-00-1632-06	0334-00-1632-15

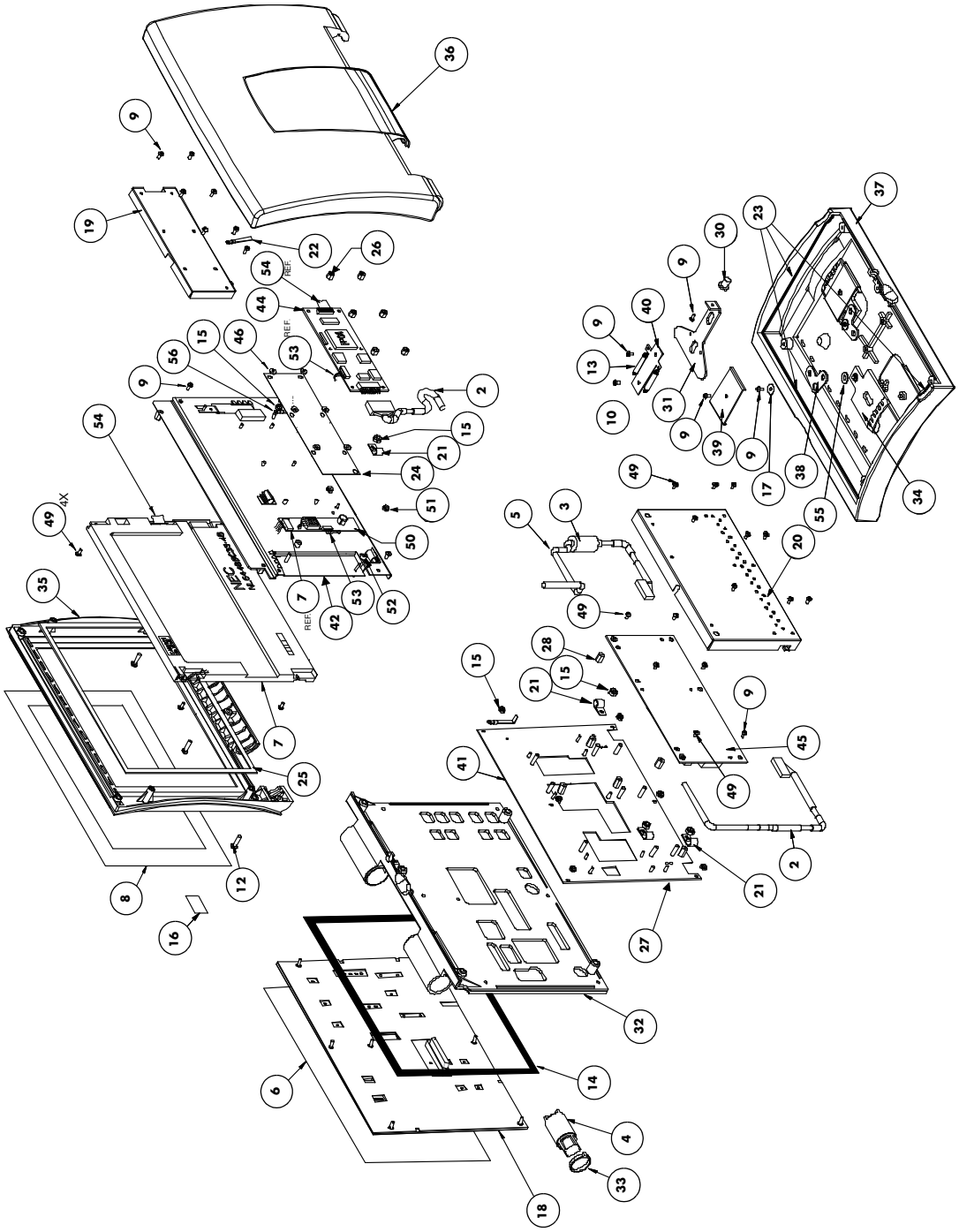


FIGURE 3-7 Isometric Drawing, Monitor Module

3.3.3 Monitor Module

FIG. NO.	DESCRIPTION	PART NUMBER
1	N/A	N/A
2	Cable, Keypad Controller To Video Receiver	0012-00-1059
3	Cable, coil cord	0012-00-1422
4	Clutch	0105-00-0071
5	Ty-wrap	0125-00-0018
6*	Keypad Label Overlay, English	0330-00-0039-01
7	Display, LCD Panel, NL6448BC33-46	0160-00-0071-02
7	Display, LCD Panel, NL6448BC33-64E	0160-00-0113
8*	Label, Display Bezel, English	0334-00-1638-01
9	Screw, #4 x 3/16″	0212-12-0403
10	Screw, #4 x 3/8″	0212-12-0406
11	Screw, #6 x 7/16″	0212-12-0607
12	Screw, #6 x 9/16″	0212-12-0609
13	Spring, extension	0214-00-0233
14	Gasket Keypad	0354-00-0110
15	Nut, stop, #4-40	0220-07-0004
16	Label, screw concealment	0334-00-2615
17	Washer, flat	0221-00-0129
18	Monitor Keypad	0331-00-0119
19	Shield, Video Receiver	0337-00-0140
20	Shield, Keypad Controller	0337-00-0113
21	Clamp, cable	0343-12-0002
22	Ground Strap, 8.60″ lg.	0346-00-0034-01
23	Gasket, lower keypad	0354-00-0109
24	Insulator, Video Receiver PCB	0349-00-0293
25	Gasket, display	0354-00-0056
26	Standoff, hex, ¼″ x 7/32″	0361-04-0072
27	Standoff, hex, 13/32″	0361-04-0069
28	Standoff, hex, 23/64″	0361-04-0070
29	N/A	N/A
30	Knob, Release	0366-00-0109
31	Lever, Release	0367-00-0057
32	Bezel, Keypad	0380-00-0516
33	Retainer, clutch	0380-00-0210
34	Docking Slide	0380-00-0479
35	Bezel, front display	0380-00-0517
36	Housing, rear display	0380-00-0499
37	Housing, bottom keyboard	0380-00-0498
38	Docking linkage	0384-00-0019

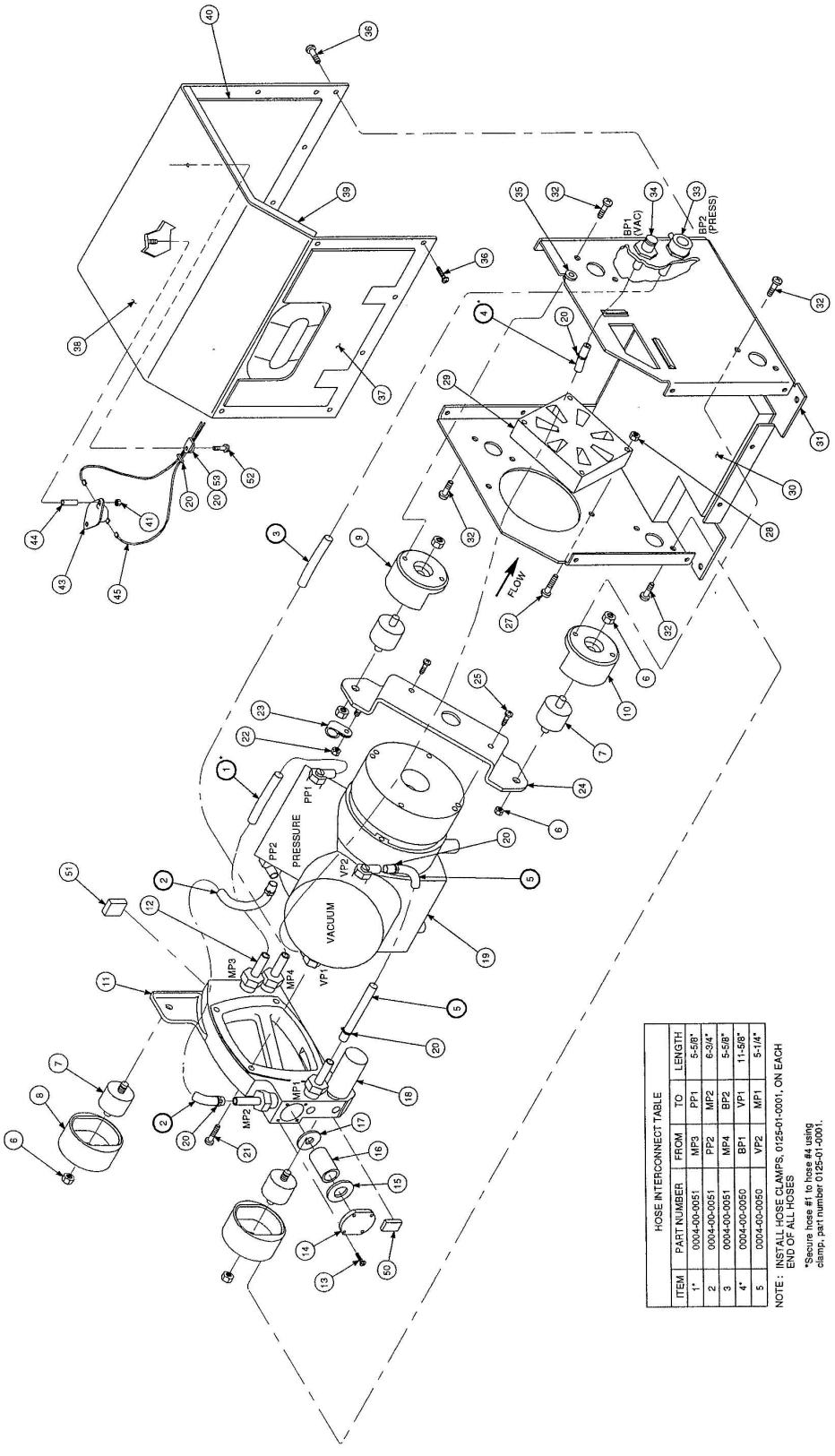
NS *Not Shown*
* *See the following table*

FIG. NO.	DESCRIPTION	PART NUMBER
39	Bracket, retainer	0406-00-0571
40	Plate, lever retainer	0406-00-0572
41	Plate, Keypad Controller mounting	0406-00-0822
42	Bracket, display mounting, NL6448BC33-46	0406-00-0818
42	Bracket, display mounting, NL6448BC33-64E	0406-00-0916
44	PCB, Video Receiver	0670-00-0736
45	Keypad Controller PCB	0670-00-1145
46	Washer, flat nylon	0210-07-0001
47	N/A	N/A
48	N/A	N/A
49	Screw, #4 x ¼"	0212-12-0404
50	PCB, Inverter	0671-00-0230
51	Nut, stop #2-56	0220-07-0002
52	Spacer, 3/16"	0361-08-0016
53	Cable, DC/AC Inverter	0012-00-1428
54	Cable, display, NL6448BC33-46	0012-00-1429
54	Cable, display, NL6448BC33-64E	0012-00-1747
55	Washer	0221-00-1025
56	N/A	N/A
NS	Cable Tie	0125-01-0001

NS *Not Shown*
* *See the following table*

3.3.4 Monitor Module International Parts List

LANGUAGE	FIG NO. 8 - DISPLAY BEZEL LABEL	FIG NO. 6 - KEYPAD LABEL OVERLAY
German	0334-00-1638-03	0330-00-0039-03
French	0334-00-1638-04	0330-00-0039-04
Spanish	0334-00-1638-05	0330-00-0039-05
Italian	0334-00-1638-07	0330-00-0039-07
Portuguese	0334-00-1638-08	0330-00-0039-08
Swedish	0334-00-1638-09	0330-00-0039-09
Japanese	0334-00-1638-06	0330-00-0039-06
Chinese	0334-00-1638-15	0330-00-0039-15



HOSE INTERCONNECT TABLE

ITEM	PART NUMBER	FROM	TO	LENGTH
1*	0004-00-0051	MP3	PP1	5-5/8"
2	0004-00-0051	PP2	MP2	6-3/4"
3	0004-00-0051	MP4	BP2	5-5/8"
4*	0004-00-0050	BP1	VP1	11-5/8"
5	0004-00-0050	VP2	MP1	5-1/4"

NOTE : INSTALL HOSE CLAMPS, 0125-01-0001, ON EACH END OF ALL HOSES

*Secure hose #1 to hose #4 using clamp, part number 0125-01-0001.

FIGURE 3-8 Isometric Drawing of Compressor Assembly

3.3.5 Compressor Assembly

FIGURE NO.	DESCRIPTION	DATASCOPE PART NUMBER
1	Pressure Hose, MP3 to PP1	0004-00-0066
2	Pressure Hose, PP2 to MP2	0004-00-0067
3	Pressure Hose, MP4 to BP2	0004-00-0068
4	Vacuum Hose, BP1 to VP1	0004-00-0069
5	Vacuum Hose, VP2 to MP1	0004-00-0070
6	Shake-proof Nut, 0.25-20	0220-06-0025
7	Shock Mount	0348-00-0169-01
8	Shock Mount Limit	0348-00-0199
9	Shock Mount Limit, Top	0348-00-0198-01
10	Shock Mount Limit, Bottom	0348-00-0198-02
11	Compressor Manifold	0391-00-0072
12	Barb Hose Fitting	0103-00-0386
13	Pan Head Screw, #2-56 X 0.375	0212-12-0206
14	Filter Access Cover	0200-00-0293
15	Filter Gasket	0354-00-0042-02
16	Filter Element	0103-00-0370
17	Filter Gasket	0354-00-0042-01
18	Muffler	0103-00-0065
19	Pump Assembly	0102-00-0001
20	Clamp	0125-01-0001
21	Pan Head Screw, M5 X 25mm	0211-00-0135
22	Shake-proof Nut, #8-32	0220-06-0008
23	Cable Clamp	0343-10-0002
24	Motor Bracket	0406-00-0568
25	Pan Head Screw, #8-32 X 0.375	0212-12-0806
27	Pan Head Screw, # 6-32 X 1	0212-12-0616
28	Hex Nut,# 6-32	0223-00-0006
29	Fan	0119-00-0149
30	Foam Insulation, Bottom	0349-00-0204
31	Pump Housing	0406-00-0569
32	Flat Head Screw, #8-32 X 0.375	0212-17-0806
33	Pressure Fitting	0103-00-0373
34	Vacuum Fitting	0103-00-0375
35	Grommet	0348-01-0012
36	Pan Head Screw, #4-40 X 0.25	0212-12-0405
37	Sound Damper, Front	0349-00-0206
38	Pump Cover	0337-00-0081
39	Foam Insulation, Pump Cover	0349-00-0240
40	Sound Damper, Rear	0349-00-0205
41	Shake-proof Nut, #4-40	0220-06-0004
43	Thermal Switch	0263-00-0003

FIGURE NO.	DESCRIPTION	DATASCOPE PART NUMBER
44	Spacer	0361-32-0500
45	Cable	0012-00-0893-02
50	Bumper	0348-00-0179
51	Bumper	0348-00-0180
52	Pan Head Screw, #6-32 x 0.18	0212-12-0603
53	Tie Anchor Mount	0125-00-0019

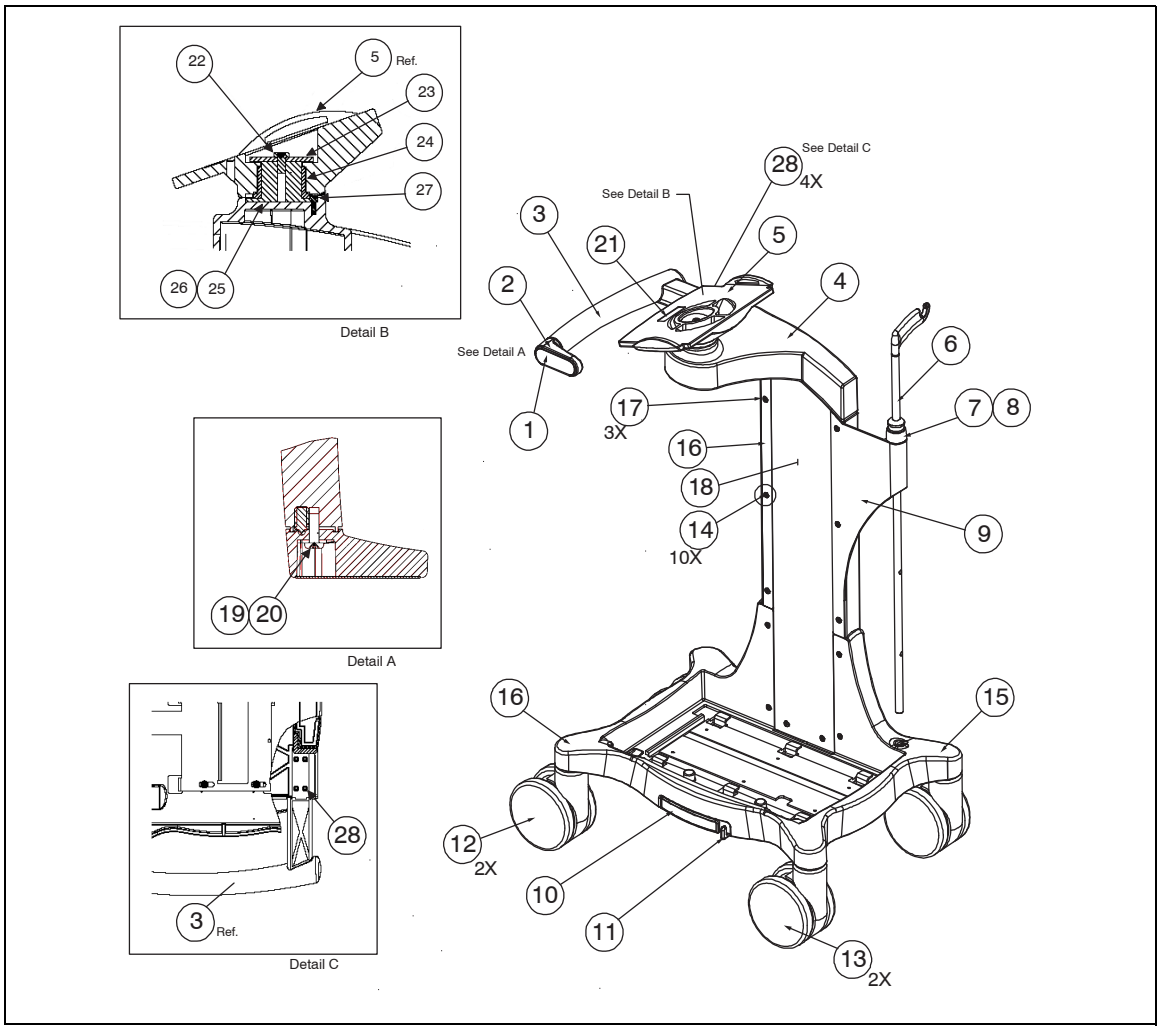


FIGURE 3-9 Isometric Drawing, Cart Door

3.3.6 Cart Assembly

FIG. NO.	DESCRIPTION	PART NUMBER
1	Latch cover, handle	0367-00-0088
2	Latch, handle	0380-00-0508
3	Handle, cart	0367-00-0090
4	Mount, display, cart	0367-00-0093
5	Platform, display, cart	0345-00-0030
6	IV pole	0436-00-0199
7	Shaft collar, self locking	0105-00-0114
8	Bushing, pole mount	0358-00-0063
9	Holder, IV pole	0406-00-0858

* *See "Cart Assembly International Parts List" on page 3-27*

NS Not Shown

FIG. NO.		DESCRIPTION	PART NUMBER
10		Handle, console release	0367-00-0092
10a		Screw for Handle, console release, 10-32 x .37 Lg Pan Hd	0216-02-1006
11		Latch, console release	0367-00-0091
11a		Shoulder Screw for Latch, console release, 4-40 x .375 Lg	0212-00-0096
12		Caster, dual function	0401-00-0040
13		Caster, maxi-lock	0401-00-0039
14		Screw, 10-32 x .62 Lg 100 deg Flt Hd	0212-22-1010
15		Base, cart	0426-00-0084
16		Plate, filler	0386-00-0324
17		Screw, 10-32 x .87 Lg 100 deg Flt Hd	0212-22-1014
18		Vertical support	0426-00-0085
19		Washer, flat	0221-00-0025
20		Screw, 1/4-28 x .75 Lg SS Pan Hd	0216-00-2512
21	*	Label, Monitor Mounting, English	0334-00-2610-01
22		Screw, 1/4-20 x .50 Lg	0212-12-2508
23		Retainer, swivel	0221-00-0115
24		Bearing, Display	0402-00-0004
25		Shaft, platform	0384-00-0026
26		Screw, #6-32 x .31 Lg 82° Flt. Hd	0212-14-0605
27		Screw, #6-32 x .75 Lg. SS Soc Hd Cap	0212-07-0612-02
28		Screw, #10-32 x .62 Lg. SS Soc Hd Cap	0212-07-1020-12
NS		Locking Bracket	0406-00-0860
NS		Spring Extension	0214-00-0216
NS		Washer, Delrin	0221-00-0122
NS		Washer, Shoulder, Delrin	0221-00-0120

* *See "Cart Assembly International Parts List" on page 3-27*

NS Not Shown

3.3.7 Cart Assembly International Parts List

FIG. NO.	DESCRIPTION	GERMAN PART NUMBER	FRENCH PART NUMBER	SPANISH PART NUMBER
21	Label, Release	0334-00-2610-03	0334-00-2610-04	0334-00-2610-05

FIG. NO.	DESCRIPTION	JAPANESE PART NUMBER	ITALIAN PART NUMBER	PORTUGUESE PART NUMBER
21	Label, Release	0334-00-2610-06	0334-00-2610-07	0334-00-2610-08

FIG. NO.	DESCRIPTION	SWEDISH PART NUMBER	CHINESE PART NUMBER
21	Label, Release	0334-00-2610-09	0334-00-2610-15

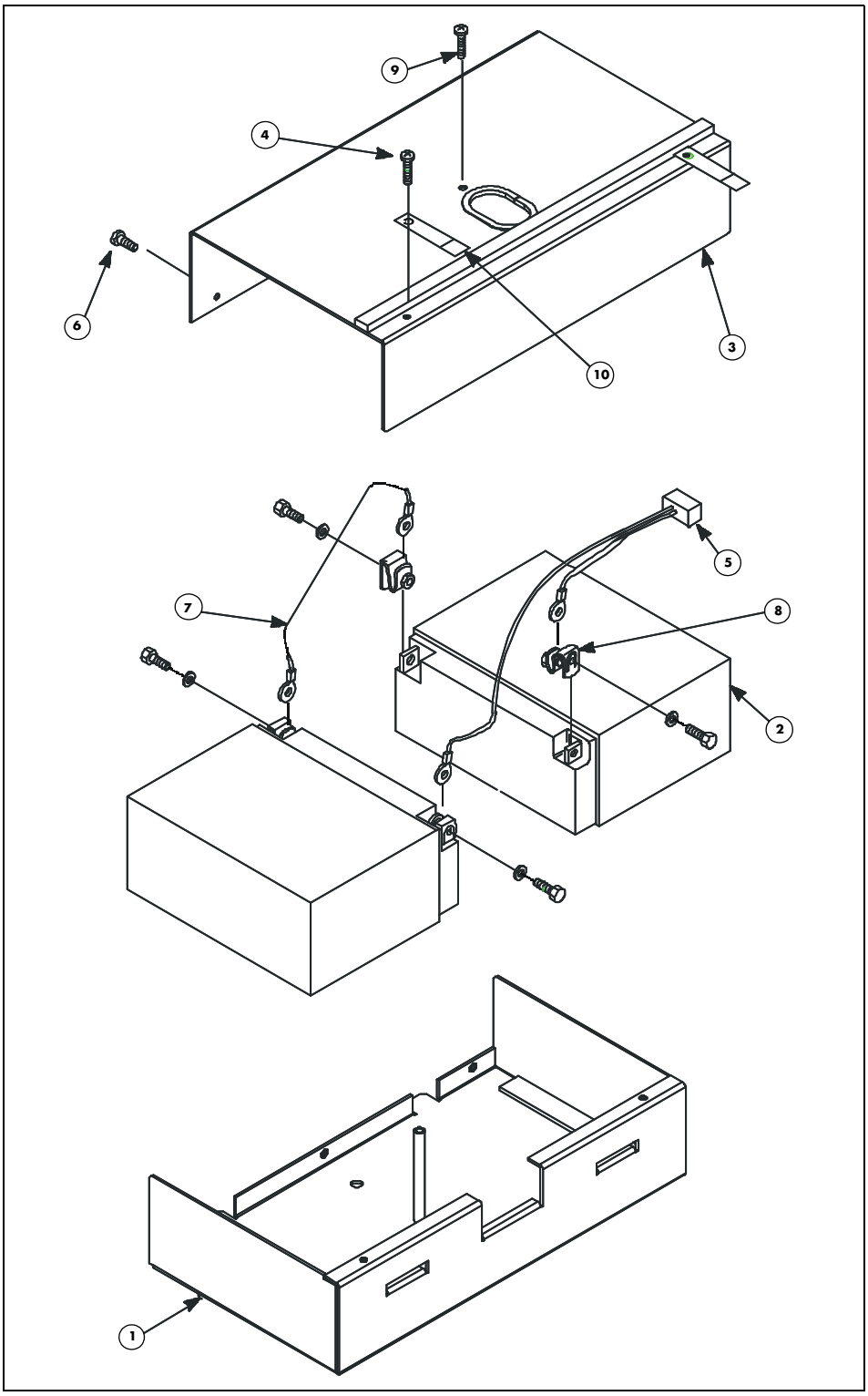


FIGURE 3-10 Isometric Drawing, UTS Battery Assembly
0146-00-0051

FIG. NO.	DESCRIPTION	PART NUMBER
1	Battery Pack Housing	0441-00-0086
2	Battery	0146-00-0039
3	Battery Pack Cover	0198-00-0006
4	Screw, pan hd, #6-32 x 0.312"	0212-12-0605
5	Cable, Battery to Connector	0012-00-0963
6	Screw, flat hd, #6-32 x 0.19" x 100°	0212-17-0603
7	Fusible Link-0603	0011-00-0015
8	Terminal Nut #10-32	0220-00-0082
9	Screw, pan hd, #10-32 x 0.375"	0216-02-1006
10	Strap	0346-00-0040

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4.0 *Calibration Procedure*

4.1 Introduction

This section provides detailed information required to properly test and calibrate the **CS300**. Calibration consists of making mechanical and electrical adjustments with the proper test equipment. The instrument should be tested and calibrated after repairs have been completed or at regular intervals as part of a preventive maintenance procedure.

NOTE: **Both calibration and a functional test must be performed to verify complete and proper operation.**

NOTE: **Calibration is conducted in normal operating mode and in Service Diagnostic mode.**

4.2 Warnings And General Guidelines

1. Before disconnecting any pneumatic hoses, the hoses and mating fittings should be tagged to show the proper connections. When reconnecting, all hoses must be checked for proper connection. To further assure proper connection, all pneumatic calibrations and tests defined in this manual should be accomplished before use on a patient.
2. Once the instrument covers have been removed, an electric shock hazard may exist. Therefore, calibration should only be performed by qualified service personnel who proceed with care and follow proper servicing techniques.
3. Do not attempt to calibrate the instrument without the test equipment and special tools listed in section 4.2.1, "Test Equipment and Special Tools Required".
4. Exercise care when reaching into the opened instrument which contains line (mains) voltage.
5. When making adjustments and measurements, avoid accidental shorting of component leads that can result in component failure.
6. Perform all steps in the order given. Do not skip any steps unless otherwise noted.
7. Understand each step of the procedure thoroughly before performing the procedure.
8. Before removing or replacing any circuit boards, disconnect the **CS300** from line power and switch the IABP ON/OFF switch to the OFF position.

4.2.1 Test Equipment and Special Tools Required

Test Equipment Required

- Dual trace oscilloscope
- Digital multimeter (3-1/2 Digits)
- ECG simulator and signal generator
- Digital Pressure Manometer, with ± 0.25 mmHg full scale accuracy, and the display resolution must have 2 decimal places. (i.e. 200.00 mmHg)

  Examples:

  (0-500mm range, F.S. accuracy .05% = ± 0.25 mmHg)

  (0-20PSI or 0-1034mmhg range, F.S. accuracy .025% = ± 0.25 mmHg)
- Safety analyzer
- Centimeter ruler
- System Trainer

Special Items Required

- Non-wired 1/4" stereo phone plug (P/N 0134-00-0016)
- 45.75 cc calibration chamber (P/N 0683-00-0314)
- 38.5 cc precision calibrated syringe (P/N 0453-00-0154)
- 60 cc syringe (P/N 0103-00-0026)
- Luer plug (P/N 0103-00-0211)
- Helium cylinder
- Catheter extender (P/N 0684-00-0182)
- 40 cc Datascope balloon
- Sensor Module Tester (P/N 0992-00-0245)
- Low Level Output Cable (0012-00-1589-02)
- Atmospheric transducer tubing adapter (see FIGURE 4-1)

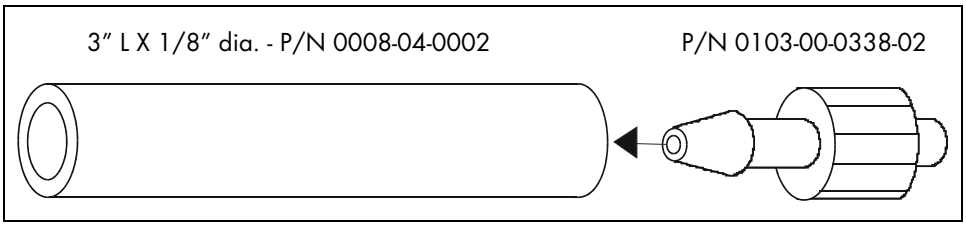


FIGURE 4-1 Atmospheric Transducer Tubing Adapter

- 0 - 30 inch pound torque limiting screwdriver (with 4 mm hex bit)*
- Loctite #242 thread locker*

* Only required for compressor maintenance.

4.3 Calibration

4.3.1 Preliminary Steps

A thorough understanding of the operation of the **CS300** is recommended before attempting calibration. See "Repair Information" on page 2-1 of this manual for a description.

4.3.2 Initial Set-up for Calibration

1. Switch the IABP ON/OFF switch to **ON**. The **CS300** has its own internal power-up diagnostics. The System will automatically sequence through the tests every time it is powered on. If all tests are successful, the advisory message "**System Test OK**" is displayed.
2. Loosen and remove the two (2) screws at the bottom of the right side cover (speaker side) and loosen the four (4) screws on the top cover. Slide the right side cover up and toward you to remove it.
3. Loosen the flat-blade captive screws on the electronics panel. Carefully open the panel only far enough to reach the connectors at J1 and J7 (large connectors at the top edge of the Front End board) and J6 (captive ribbon cable on the Front End board). Unplug the cables and open the panel.

4.3.3 Power-Up Test Routine

1. If a power-up self-test subsystem fails, the screen will display the advisory message "**Electrical Test Fails Code #__**". If a power-up self-test of the monitor subsystem fails, the recorder will attempt to print an error code. See "Repair Information" on page 2-1 of this manual for a complete listing of failure codes.
2. If the **CS300** has been powered off for more than 15 minutes, then all controls will power up in their default settings. If it has been less than 15 minutes, switch the IABP ON/OFF switch to **ON** while pressing and holding the **OPEN MENU** key. The default settings will be reinstated.

See section 4.3.4, "Service Diagnostics" for additional checks and calibration procedures.

4.3.4 Service Diagnostics

4.3.4.1 User Interface

All IABP controls become nonfunctional after entering Service Diagnostic mode. All Service Diagnostic user input is provided through the keys indicated by the black arrows in FIGURE 4-2.

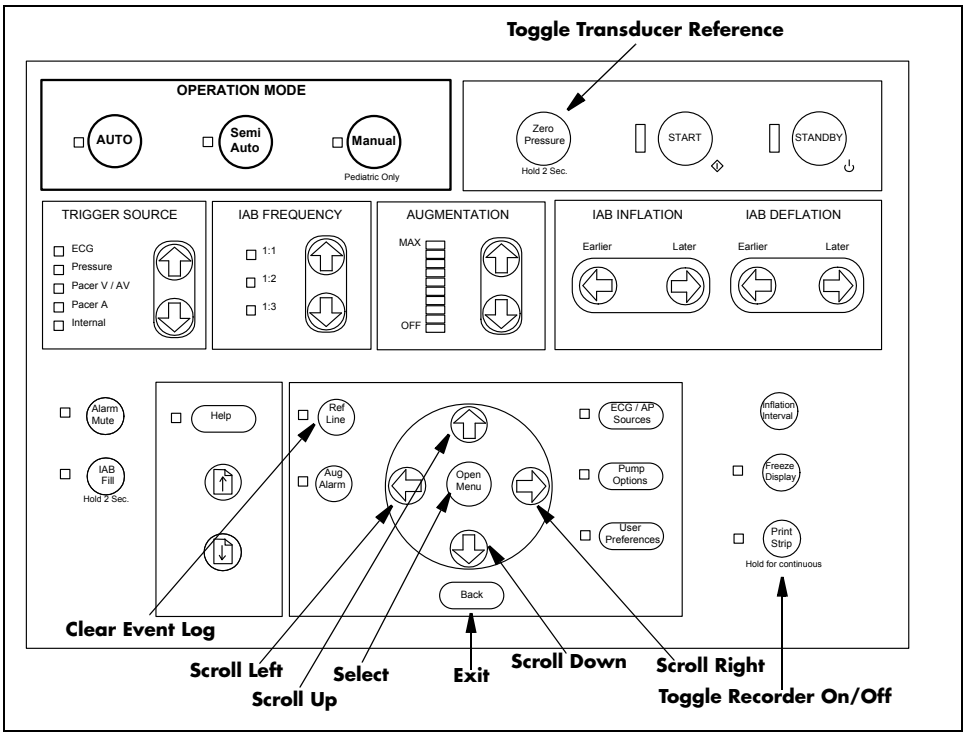


FIGURE 4-2 User Interface

To enter Service Diagnostics, press and hold the **INFLATION INTERVAL** and the **FREEZE DISPLAY** keys on the Monitor keypad while powering on the **CS300**. Continue to hold the keys until the Datascope logo is displayed. Following the logo is the warning screen:

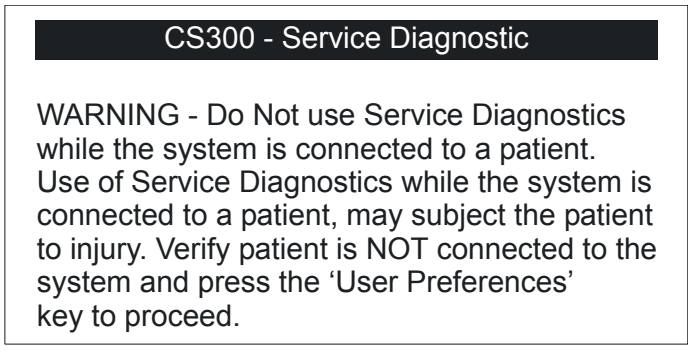

CS300 - Service Diagnostic
WARNING - Do Not use Service Diagnostics while the system is connected to a patient. Use of Service Diagnostics while the system is connected to a patient, may subject the patient to injury. Verify patient is NOT connected to the system and press the 'User Preferences' key to proceed.

FIGURE 4-3 Service Diagnostic Warning

4.3.5 Power Supply Checks

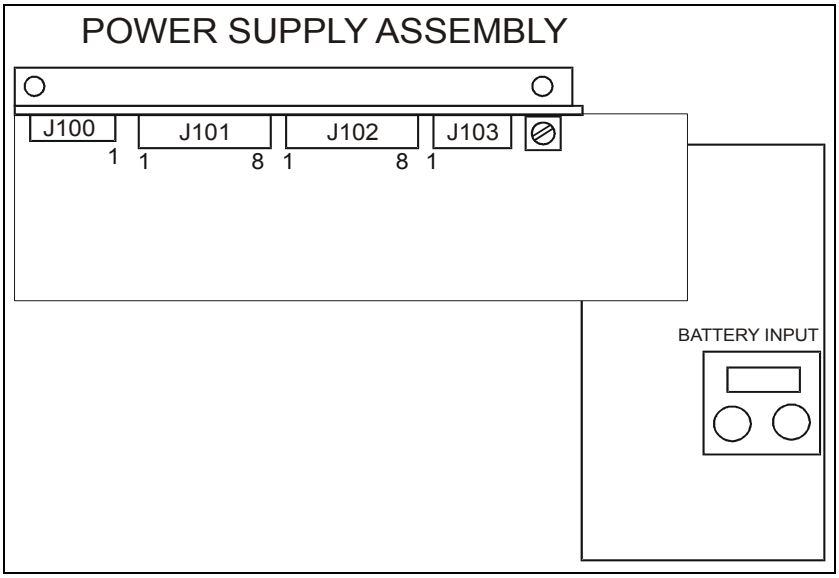


FIGURE 4-4 Power Supply Assembly

1. Operating from AC power, verify that the red LEDs CR4 through CR9 on the Main Board are illuminated. Check that the voltages at J101 and J102 of the power supply assembly are within the following tolerances:

PIN NUMBER			
+ LEAD	**- LEAD**	**VOLTAGE**	**RANGE**
5	4	+5V	5.1V to 5.2V
1	2	+12V	11.75V to 12.25V
3	2	-12V	-11.75V to -12.6V
7	8	24V	22.8V to 25.2V

2. Select Pneumatic System Test and verify that the voltages displayed in the status box are within ±5% of the measured voltages.
3. With the BATTERY CHARGING indicator illuminated in a steady state, verify that the battery voltage reads between 27 and 28 volts.
4. To ensure a high current charging state, switch AC MAINS to OFF and operate the System on battery for a maximum of 30 seconds. Switch AC MAINS back ON and verify that the battery current display reads between 4c and 5c.
5. Perform the remainder of the calibration and functional test while operating from the battery. Ensure that the batteries have been fully charged for a minimum of 18 hours. Make a note of the time at the start of the procedure and note the time when the System shuts down. This period should exceed 2.25 hours. If testing is completed before the specified time has elapsed, then continue battery operation at 120 BPM until you reach the specified time. Battery replacement is suggested if operating time is marginal.

NOTE: Inform the end user that the IABP will not provide full battery operation until the battery has been charged for 18 hours.

NOTE: **To test the battery run time it is suggested that the remainder of the calibration procedure be performed while operating from the battery. Ensure that the batteries have been fully charged for a minimum of 18 hours. Make a note of the time at the start of the procedure and note the time when the System shuts down. This period should exceed the specifications listed in this manual (see "Specifications" in the CS300 Operator's manual). Battery replacement is suggested if operating time is marginal.**

4.3.6 Recorder Time

1. Note the reading on the Timer prior to the start of calibration.

4.3.7 Reference Voltage Check

1. Refer to the calibration test point locations in FIGURE 4-15 on page 4-29. Connect a DVM between TP22 and TP33 (GND_A) on the Front End board.
2. Adjust R253 on the Front End board for 5V ±0.1V.

4.3.8 Internal Transducer Check

1. From the Main Menu, press the **OPEN MENU** key to enter the Pneumatic System Test screen. Note the transducer offset values displayed in brackets ( ) next to the Atmospheric and Shuttle transducers.
2. If these readings are between -4 mmHg and 4 mmHg, calibration of the transducers is not required. If not, calibrate the Balloon (shuttle), Atmospheric and Drive transducers as per the following 3 sections. All three transducers must be calibrated.
3. Press the **BACK** key to exit the Pneumatic System Test screen.

NOTE: **The Shuttle, Atmosphere, and Drive transducers are ABSOLUTE pressure transducers. As such, the offset of the transducer needs to be adjusted according to the ABSOLUTE atmospheric air pressure when making any adjustments. This is NOT the same pressure which is given by weather stations as barometric pressure, which is compensated for elevation and referenced to sea level. Weather station readings would only be valid if you are at, or close to sea level in elevation.**

4.3.9 Balloon (Shuttle) Transducer Calibration

NOTE: **For proper system performance, the Shuttle transducer needs to be accurately calibrated. It is recommended that recalibration only be done as necessary after Front End board replacement, Shuttle transducer replacement, or if the gain or offset readings of the Shuttle transducer were found to be out of specification. Use of a precision instrument is required for this calibration. (See "Test Equipment Required")**

1. Remove the tubing from the IAB FILL PORT on the Safety Disk and connect the tubing to a precision digital manometer.
2. Refer to FIGURE 4-15 on page 4-29 for test points and calibration pot locations. Connect a DVM to the BALLOON-PRESS signal at TP23 and ground at TP33 (GND_A) of the Front End board.
3. Note the offset voltage with 0 mmHg of pressure applied. Apply 380.00 mmHg from the manometer and note this voltage. The difference between the two readings should be 1.900VDC ± 0.002V. If within range, skip to step 5. If not, continue to step 4.
4. Adjust R199 (GAIN) on the Front End board for a difference between the two voltage readings of 1.900VDC ± 0.002V. Repeat until this difference is achieved.
5. The transducer offset is calibrated using the absolute atmospheric pressure expressed in mmHg. If the local absolute atmospheric pressure is not available, call the local airport and ask for an altimeter reading or use the table that follows:

$$\frac{Absolute\ atmosphere\ pressure}{200mmHg} - 3.8V = V\ offset$$

For example, 760 mmHg (standard atmospheric pressure at sea level) will equal an offset voltage of 0.000 volts.

$$\frac{760mmHg}{200mmHg} - 3.8V = O\ V\ offset$$

Another example: At an elevation of 5000 feet, the absolute atmospheric pressure is normally 632 mmhg. This will equal an offset voltage of –0.640 Volts.

$$\frac{632mmHg}{200mmHg} - 3.8V = -0.640\ V\ offset$$

NOTE: If the absolute atmospheric pressure is unavailable, use the following table:

ALTITUDE (ft)	PRESSURE (mmHg)	VOLTAGE OFFSET
Sea Level	760	0
1000	733	-0.14
2000	707	-0.27
3000	681	-0.40
4000	656	-0.52
5000	632	-0.64
6000	609	-0.76
7000	586	-0.87
8000	564	-0.98
9000	543	-1.09
10000	523	-1.19

6. Apply 0 mmHg and adjust R202 (offset) to the calculated value ±0.005V. Apply 380 mmHg and verify that the difference is still 1.900V ±0.002V.
7. Reconnect the IAB FILL PORT tubing to the Safety Disk.

4.3.10 Atmospheric Transducer Calibration

1. Refer to FIGURE 4-15 on page 4-29 for test points and calibration pot locations. Use the tubing adapter, shown in section 4.2.1, to attach the digital manometer to the atmospheric transducer (U54) on the Front End board. Slide the tubing over the port on the transducer.
2. Connect a DVM to the ATMOS-PRESS signal at TP26 and ground at TP33 (GND_A) of the Front End board.
3. Note the offset voltage with 0 mmHg of pressure applied. Apply 200 mmHg from the manometer and note this voltage. The difference between the two readings should be 1VDC ± 0.01V. If within range, skip to step 5. If not, continue to step 4.
4. Adjust R225 (GAIN) on the Front End board for a difference between the two voltage readings of 1 VDC ±0.01V. Repeat until this difference is achieved.
5. The transducer offset is calibrated using the current absolute atmospheric pressure expressed in mmHg. Use the value calculated for the Balloon transducer calibration.
6. Apply 0 mmHg and adjust R229 (OFFSET) to the calculated value. Apply 200 mmHg and verify that the difference is still 1V ± 0.01V.
7. Power down the system and re-enter the Service Diagnostic mode.

4.3.11 Drive Transducer Calibration

1. Refer to FIGURE 4-15 on page 4-29 for test points and calibration pot locations.
2. Connect a DVM to TP24 (DRIVE_PRES signal) and ground (GND_A) at TP33 of the Front End PCB.
3. Select the Pneumatic System Test from the Main Menu and press the **ZERO PRESSURE** key to change the atmospheric reference to zero.

4. Activate the K6A solenoid to close it to atmosphere. Activate K7 to apply a vacuum to the diaphragm of the Safety Disk. Use a luer cap to close the IAB Catheter Extender Input port of the Safety Disk. De-activate K7.
5. Activate and de-activate K8 to pressurize the drive transducer.

NOTE: If the drive pressure readings continue to decrease, there is a leak in the drive pneumatics. Run the K6, K6A, K7, K8 Leak Test. Repair as necessary.

6. Adjust R212 (GAIN) on the Front End PCB so that the Drive transducer reading is equivalent to the Shuttle transducer reading (± 2 mmHg). Select K6A to vent the drive pressure and remove the luer cap. Adjust R216 (OFFSET) so that the drive pressure reads zero.
7. Repeat steps 4 through 6 until no difference is noted between the Shuttle and Drive transducers.
8. Remove the luer cap from the Safety Disk and select Safe State. With the solenoids at their normal state, adjust R216 (OFFSET) so that the offset on the DVM reads the same value that was calculated for the balloon transducer calibration.
9. Recycle the power into Service Diagnostics mode and select Pneumatic System test. Verify that the Atmospheric, Shuttle and Drive transducer readings are within 2 mmHg of each other, and that the offset values in brackets for Atmospheric and Shuttle (not helium) are between -4 mmHg and +4 mmHg.

4.3.12 Safety Disk Leak Test

This test is functionally equivalent to the leak test that is included in the **CS300** operating software. The primary differences are, the ability to halt a test in progress by pressing the **BACK** key, and the display of test status messages and elapsed time. Three separate leak tests are performed. First, K3 is activated thereby pneumatically removing it from the circuit. The system checks for a vacuum leak, which could be caused by a hole in the safety disk membrane or a leak through the K5 solenoid. After two minutes, K3 is de-activated (closing the valve) and K5 is activated (pneumatically removing it from the circuit). The system again checks for vacuum leaks which could be caused by a hole in the safety disk membrane or a leak through the K3 solenoid. After two minutes, K5 is de-activated (closing the valve) and K8 is activated causing the safety disk to pressurize. The third test will then begin.

During the entire test, status messages will inform the user when tests are completed. At the conclusion of each test, the pressure change is posted. A change that is greater than ±4 mmHg for any of the tests indicates that there is a leak in the system. A luer plug, P/N 0103-00-0211, is required for this test.

1. Select **Functional Tests** from the Main Menu and then select **Safety Disk Leak Test** from the submenu.
2. With the IAB catheter port of the Safety Disk unplugged, press the **OPEN MENU** key to start the test. Wait for a tone to sound and the instruction "**Plug Safety Disk**". Immediately seal the IAB catheter port using the luer plug. If the test is started with the IAB port already plugged, the instruction "**Unplug Safety Disk**" is displayed. Unplug the port and wait for the "**Plug Safety Disk**" instruction. The test will take approximately 6.5 minutes to complete.
3. Press the **BACK** key to return to the Functional Tests screen.

4.3.13 K6, K6A, K7, K8 Leak Test

This test checks for leaks in the drive section of the pneumatics. The drive section is first vented to atmosphere and held for 60 seconds, then pressurized to approximately 8 PSI and held for 60 seconds and then evacuated and held for 60 seconds. X2, the drive transducer is read to determine the pressure during these periods. The pneumatic schematic is displayed on screen along with the measurement box and a test status box. The test status box contains the current status of the test, the pressure difference from start to end of test and the elapsed time (in seconds).

1. Select **Functional Tests** from the Main Menu and then select **K6, K6A, K7, K8 Leak Test** from the submenu.
2. With the IAB catheter port of the Safety Disk unplugged, press the **OPEN MENU** key to start the test. Wait for a tone to sound and the instruction "**Plug Safety Disk**". Seal the IAB catheter port using the luer plug. If the test is started with the IAB port already plugged, the instruction "**Plug Safety Disk**" will not appear and testing will proceed.
3. At the start of the test, K3 and K5 are activated to purge the shuttle side of the Safety Disk to below 200 mmHg, and K6 is activated until the drive pneumatics are vented to atmosphere. When these levels are reached, K3, K5 and K6 are deactivated and K6A is activated. This first portion of the test is 60 seconds in length and checks for leaks at K7 and K8. After 60 seconds of Elapsed Time, the timer stops and the differential pressure is posted in the Test #1 section.

   The timer restarts and the second portion of the test activates K8 to pressurize the drive side of the Safety Disk to approximately 8 PSI. This portion of the test is 60 seconds in length and checks for leaks to atmosphere through K6 or K6A, or a vacuum leak through K7. At 120 seconds of Elapsed Time, the timer stops and the differential pressure is posted in the Test #2 section.

   The timer restarts and the third portion of the test rapidly toggles K6A and K7 until a partial vacuum is achieved. This portion of the test is 60 seconds in length and checks for leaks to atmosphere through K6 or K6A, or a pressure leak through K8. At 180 seconds of Elapsed Time, the timer stops and the differential pressure is posted in the Test #3 section.

TEST	ACCEPTABLE LEVEL
TEST # 1	±45 mmHg
TEST # 2	±65 mmHg
TEST # 3	±20 mmHg

4. Press the **BACK** key to return to the Functional Tests screen.

4.3.14 Pressure Regulator and Vacuum Check

1. From the Main Menu select **Pneumatic System Test**. Use the **OPEN MENU UP** and **DOWN** keys and the **OPEN MENU** key to activate K6A (to close the solenoid) and K7 (to open the solenoid). Verify that X2-Drive-Pres reads between 0 and 125 mmHg. A lower number indicates more vacuum. A higher reading may indicate a leak in the pneumatic system or the need to rebuild the pump motor. Select **Safe State** to deactivate K6A and K7.
2. Press **ZERO PRESSURE** to change the pressure reference to atmosphere. Use the **OPEN MENU UP** and **DOWN** keys and the **OPEN MENU** key to activate K6A and K8. Verify that the X2-Drive-Pres. reads between 375 and 413 mmHg. If necessary adjust the 8 PSI regulator so that the pressure is within this range.
3. Press the **BACK** key to return to the Main Menu.

4.3.15 Autofill Calibration

NOTE: The System must pass the previous leak tests prior to this calibration.

1. Select **Autofill Calibration** from the Functional Tests menu. Ensure that there is adequate helium pressure by verifying that helium pressure (X4) (as shown on the pneumatic drawing) shows a pressure greater than 215 PSIG.
2. Connect the calibrated 38.5 cc syringe (P/N 0453-00-0154) to the female luer fitting on the calibration chamber (P/N 0683-00-0314). Connect the other port of the calibration chamber to the IAB CATHETER EXTENDER INPUT fitting on the Safety Disk. Press the **ZERO PRESSURE** key to change the atmospheric reference to "0" (zero).
3. Ensure that all of the gas is expelled from the calibrated 38.5 cc syringe.
4. Press the **OPEN MENU** key to initiate an Autofill. As the syringe is filling, it may require some assistance by slowly pulling the plunger until it reaches the stop point.
5. Remove the calibration chamber from the unit, expel all of the helium from the syringe and then re-connect it to the unit. Press the **OPEN MENU** key to initiate another Autofill. When the plunger has reached the stop point, read the shuttle pressure (X1) value on the display.
6. If the X1 pressure reading is between 91 and 109 mmHg, then the volume is within specification and does not need to be adjusted.

NOTE: If the shuttle pressure is out of range, the volume of gas in the volume cylinder will also be out of range and must be adjusted. To adjust, loosen the volume cylinder lock nut and rotate the screw: clockwise rotation decreases the volume, and counter-clockwise rotation increases the volume. Repeat steps 3 through 5. Make small adjustments until the X1 pressure is 100 mmHg, ± 2 mmHg. Tighten the lock nut and repeat steps 3 through 5 to ensure the accuracy of the calibration.

7. If the autofill volume is adjusted, then adjustment of the full sensor may be necessary. Verify the position of the sensor by observing the sensor LED. Initiate an autofill and verify that the FULL LED flashes twice during each autofill cycle. If the LED flashes twice, then adjustment is not needed. Skip to step 9.

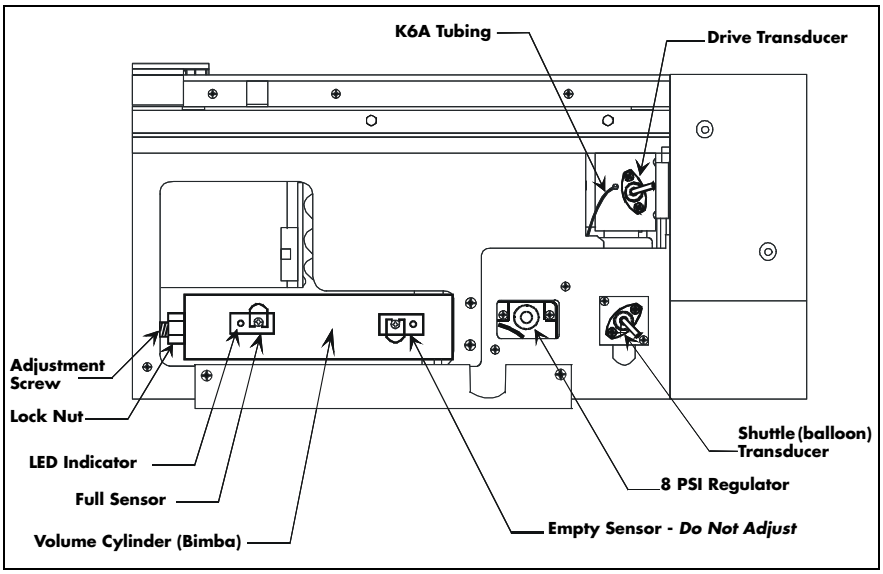


FIGURE 4-5 Pneumatic Compartment

8. Adjustment of the Full Sensor. Leave the calibration chamber and syringe connected to the Safety Disk. Exit the Autofill Calibration and Functional Tests to return to the Main Menu. Select Pneumatic System Test. Ensure that the helium tank is open. Select K1 to open the path between the helium tank and K2. Observe the FULL LED on the volume cylinder.

Loosen the sensor mounting screw and move the sensor all the way to the left (toward the adjustment screw). Slowly move the sensor back to the right until the LED turns on. Continue to move the sensor slowly until the LED just turns off. Tighten the sensor screw at this point.

Exit the Pneumatic System Test, select Functional Tests and return to the Autofill Calibration. Verify the sensor position as per step 7.

9. The Autofill status box displays the Bimba fill time. Verify that this time is between 2.5 and 6 seconds. A faster fill time could indicate an over-pressure condition of the helium regulator. Slower fill times could indicate possible leaks or flow restrictions in the fill gas path.

Verify that the Shuttle Fill time is 3 seconds maximum. A greater period indicates leaks or a flow restriction in the shuttle gas path.

Verify that the shuttle purge time is less than 9 seconds. Slower purge times indicate leaks in the shuttle gas system or marginal compressor performance.

10. Select **BACK** to exit out of Autofill Calibration selection. Select **BACK** to exit the Functional Test selection. Power the unit off by switching the ON/OFF switch to **OFF**.

4.3.16 Solenoid Driver Board Checks

Re-power the **CS300** and select Semi-Auto mode.

1. If not previously removed, remove the top cover from the System. Refer to calibration test point locations in FIGURE 4-15 on page 4-29.
2. Connect a DVM to TP2 (+) and TP5 (-) on the Solenoid Driver board (P/N 0670-00-0639) to verify the Blood Detect circuitry.
3. Verify that the voltage reading is between 2.5 and 5 volts. If the voltage is out-of-range, configure S1 (A and B) as listed in the following table to obtain a voltage in the correct range.

	S1A	**S1B**
1st Choice	Open	Open
2nd Choice	Closed	Open
3rd Choice	Open	Closed
Not Used	Closed	Closed

If the voltage is still out-of-range, it may be an indication that the Blood Back sensor has degraded or the circuitry is not functioning properly.

4. Connect a DVM to TP4 (+) and TP5 (-) on the Solenoid Driver board (P/N 0670-00-0639).
5. Verify that the voltage reading is between 1 volt and 2.3 volts. If the voltage is out-of-range, configure S1 (C and D) as listed in the following table to obtain a voltage in the correct range.

	S1C	**S1D**
1st Choice	Open	Open
2nd Choice	Closed	Open
3rd Choice	Open	Closed
Not Used	Closed	Closed

If the voltage is still out-of-range, it may be an indication that the Blood Back sensor has degraded or the circuitry is not functioning properly.

6. Remove the fill tubing from the Blood Back sensor and block the light path by sliding a piece of wire or a dark strip of paper in the tubing's place.
7. While observing the K6A LED on the Solenoid Driver board, initiate an autofill by selecting the **IAB FILL**. Verify that the System displays a "**Blood Detected**" message and that the K6A LED goes off. Power down and remove the obstruction from the sensor.
8. Place the drain tubing back in the blood sensor. Attach the catheter extender (P/N 0684-00-0182) and a 40 cc balloon to the IAB Catheter Port of the Safety Disk. Power up the System, select **SEMI-AUTO** and initiate an AUTOFILL. Verify that the system can complete an autofill.
9. Press the **START** key to initiate pumping. Verify that the voltage between L6 (side closest to JP3) and TP31 (supply to Condensate Removal Module chiller block) is 2.8V ± 0.1V.

4.3.17 Fiber Optic Test Instructions

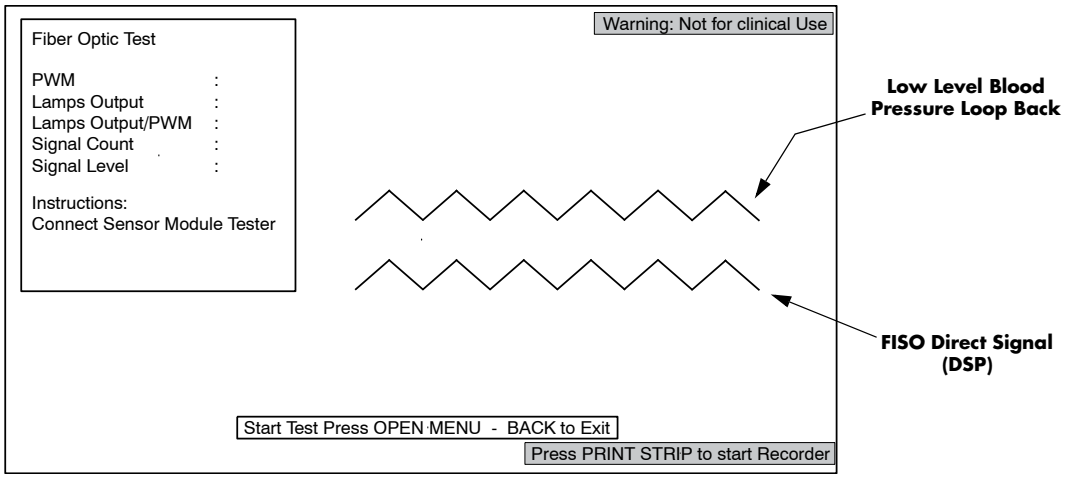

Fiber Optic Test
PWM :
Lamps Output :
Lamps Output/PWM :
Signal Count :
Signal Level :
Instructions:
Connect Sensor Module Tester
Warning: Not for clinical Use
Low Level Blood Pressure Loop Back
FISO Direct Signal (DSP)
Start Test Press OPEN MENU - BACK to Exit
Press PRINT STRIP to start Recorder

FIGURE 4-6 Fiber Optic Test

The purpose of the Fiber Optic Test is to verify the lamp function and output, Pulse Width Modulation (PWM), Signal Count, and Signal Level of the Sensor Module. This test will run for 30 seconds. The Sensor Module Tester (0992-00-0245) and a Low Level Output Cable (0012-00-1589-02) are required for this test.

1. Connect the Sensor Module Tester by inserting the Fiber Optic Connector into the IAB Sensor Input connector and connecting the tubing/luer connector to the IAB Catheter Extender Input connector.

2. Connect the Low Level Output cable between the Low Level Output from the Sensor Module (labeled "TO BEDSIDE MONITOR") and the Blood Pressure Input connector on the **CS300**.

3. Power ON the **CS300** into Service Diagnostics. Select the **FIBER OPTIC TEST** from the **FUNCTIONAL TESTS** menu.

4. Press the **OPEN MENU** to enter the test.

5. Press the **OPEN MENU** key to start the test. The unit will start pumping and display two waveforms. The two waveforms should be alike.

6. After 30 seconds, the pumping will stop and the parameters will be displayed. The test results, FOS errors, or Test Complete will be displayed as depicted in the example of FIGURE 4-7.

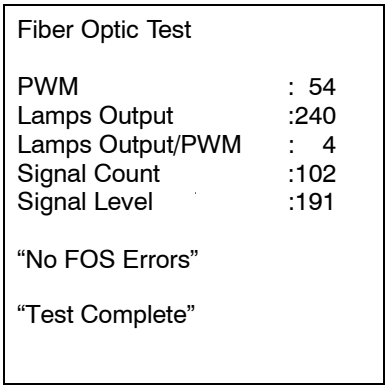


FIGURE 4-7 Example Fiber Optic Test Results

The pass / fail criteria are as follows:

PWM:	1 - 69
Lamps Output:	0 - 248
Lamps Output/PWM:	> = 3
Signal Count:	> = 55
Signal Level:	> = 153

7. If any of the first three parameters fail, then Fiber Optic Lamp Replacement is recommended (see section 5.6.9).

8. If "Sig Count" or "Sig Level" fail, then perform the Lamp Ferrule cleaning procedure (see section 5.6.8) and retest. If failure persists, replace module and retest.

9. Reattach the top cover to the System.

4.3.18 ECG Gain Calibration

NOTE: **This procedure assumes that LEAD I is selected and that signals are applied to the rear panel ECG patient connector between pin A (RA) and pin B (LA) with pin C (LL) shorted to pin B. (Typical of most ECG simulators.)**

1. Reconnect the cables to J1 and J7 on the Front End board if removed to open the door. Leave the door open enough to reach to the calibration potentiometers and test points on the board.

2. Attach the ECG signal from the simulator/signal generator. Verify the ECG display.

3. Select the Semi-Auto mode.

4. Select ECG trigger. Apply a 1 mV p-p 5 Hz sine wave* from the simulator/signal generator to the patient ECG connector on the rear panel. Set the ECG display to LEAD I.

5. Connect the oscilloscope to TP2 (ECG) and TP33 (GND_A) on the Front End PCB.

6. Adjust R52 (GAIN) for a 0.5 V p-p (±50 mV) signal. Remove the scope connection.

** Use 1 mv ECG signal if this waveform is not available.*

4.3.19 Blood Pressure Gain Calibration

1. Attach a pressure simulator or mercury column and transducer to the pressure input connector.
2. Apply 0 mmHg and zero the pressure channel by pressing the **ZERO PRESSURE** key until two clicks are heard. Verify that the pressure trace merges with the baseline and the digital display reads zero.
3. Connect a DVM to TP48 (INT-PRESSURE) and TP33 (GND_A).
4. Apply 150 mmHg from the simulator and adjust R128 (BP Gain) on the Front End board for a 1.50 V (±10 mV) output. Verify that the MEAN display shows 150 mmHg (±3 mmHg).

NOTE: **If interfacing with an external monitor with other than 0 mmHg = 0 volt offset, adjust R134 to compensate for the external monitor offset. Install the jumper at JB2 between pins 1 and 2 on the Front End board (move from pins 2 and 3 which is the normal position used where the monitor is 0 mmHg = 0 volt). Connect the "zeroed" external monitor to the CS300 Monitor Input Pressure phone jack and adjust R134 for 0 mmHg on the display.**

4.4 Functional Tests

(Test with CS300 Completely Assembled)

4.4.1 Keypad / Switch Test

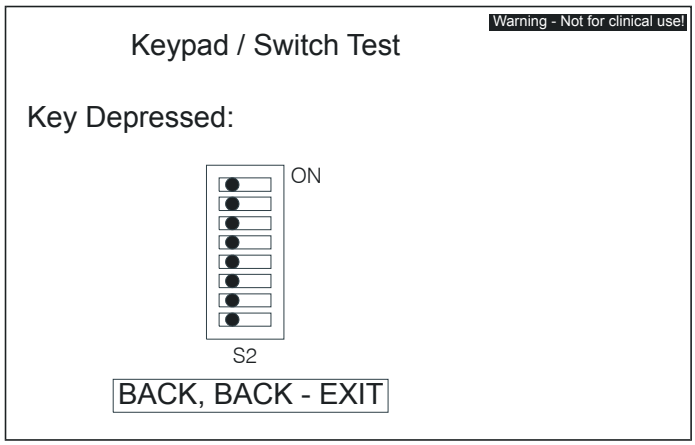


FIGURE 4-8 Keypad / Switch Test Screen

1. Enter the Service Diagnostic mode and select **Keypad / Switch Test** from the Main Menu.
2. Press all keys on the Monitor keypad. Verify that the corresponding key is identified in the **Key Depressed** field of the display. Verify that LEDs associated with keys are lit when the keys are pressed.
3. Press the **BACK** key twice to return to Main Menu.

4.4.2 External RS-232 Port Test

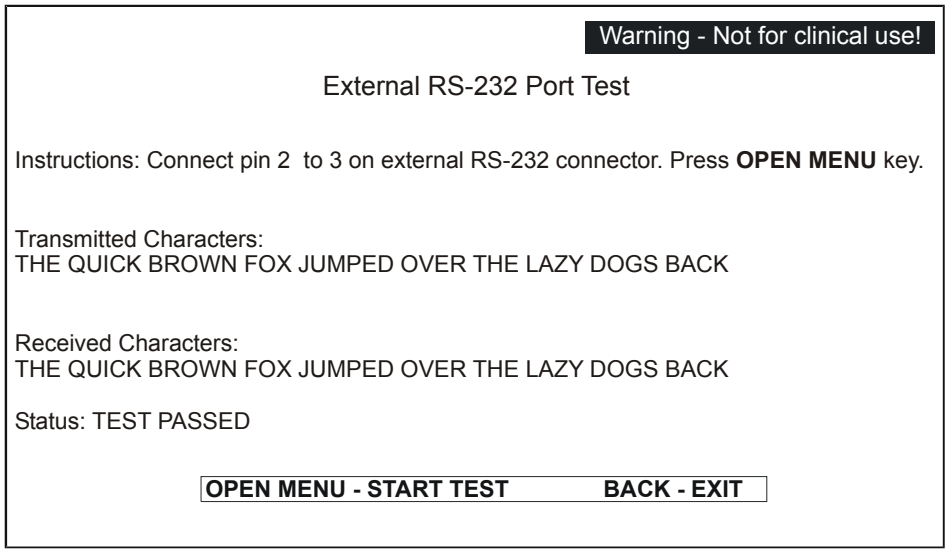
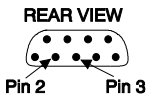

Warning - Not for clinical use!
External RS-232 Port Test
Instructions: Connect pin 2 to 3 on external RS-232 connector. Press OPEN MENU key.
Transmitted Characters:
THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
Received Characters:
THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK
Status: TEST PASSED
OPEN MENU - START TEST
BACK - EXIT

FIGURE 4-9 RS-232 Test Screen

The purpose of this test is to verify the integrity of the RS-232 channel. The transmit and receive pins need to be connected together on the rear panel RS-232 connector. This action will allow the serial communication channels to transmit data and receive back the data that is sent.



1. Select External RS-232 Port Test from the Main Menu.
2. Use bus wire to jump pins 2 and 3 (transmit and receive lines) of the rear panel RS-232 connector together.
3. Press the **OPEN MENU** key to run the test. Transmitted characters are compared to received characters until the entire test string "**THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK**" has been sent.
4. The **Status** line will indicate if the test passes. If the data is received incorrectly or data is missing the test will fail and display "**Incorrect or no characters received**". The test will also fail if the transmit and receive pins are not jumped together.
5. Remove the jumper.
6. Press the **BACK** key to exit the test.

4.4.3 Modem Test

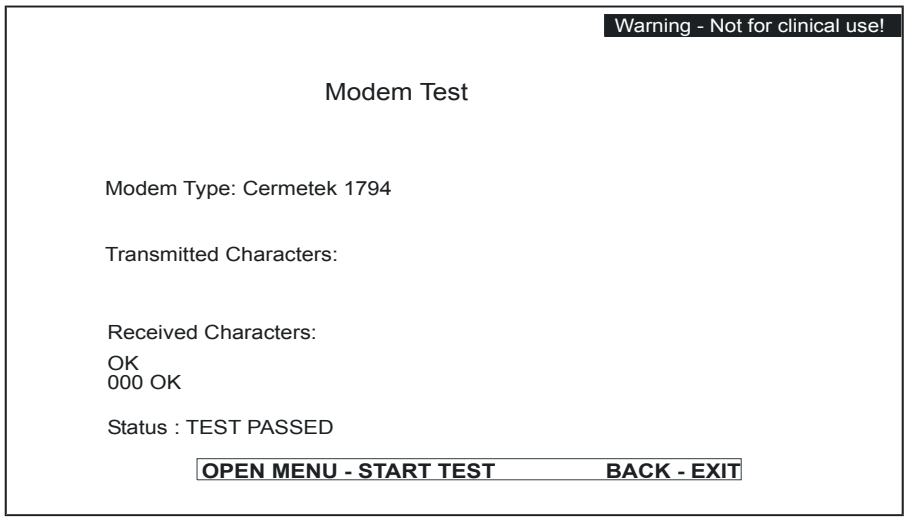


FIGURE 4-10 Modem Test Screen for Cermetek Modem

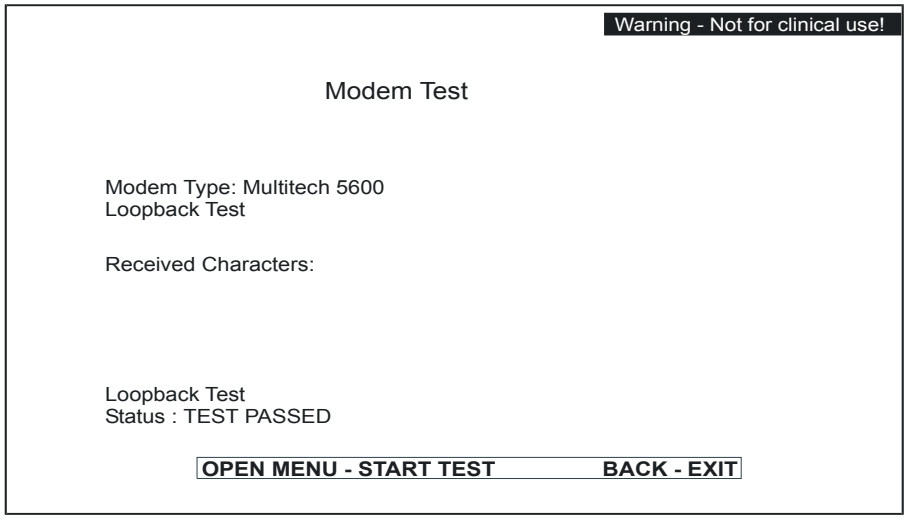


FIGURE 4-11 Modem Test Screen for MultiTech Modem

1. Select **Modem Test** from the Main Menu.
2. Press the **OPEN MENU** key and verify that "**test passed**" is displayed in the **Status** area.
3. Press the **BACK** key to exit the test.

4.4.4 Recorder Test

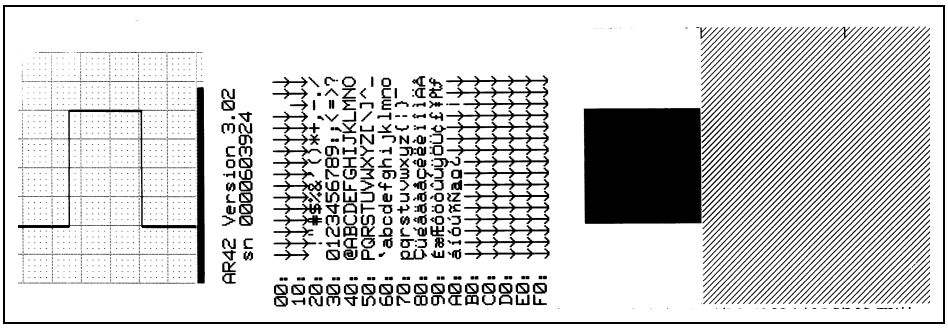


FIGURE 4-12 Recorder Test Strip

1. Select **Recorder Test** from the Main Menu.
2. Verify the following:
   - **a.** 5 mm grid is printed with 1 mm subdivisions. Measure the span of 10 grids and verify that it is equal to 5 cm.
   - **b.** Verify that the 60 bpm square wave is 2 cm peak to peak.
   - **c.** A solid bar is printed. Examine the bar and ensure that all of the pixels are operating.
   - **d.** Verify that the character set is printed as shown above.
3. Press the **BACK** key to exit the test.

4.4.5 Motor Calibration/Test

This test verifies the integrity of the motor speed circuitry on the Main Board, the Motor Controller Board, the DC Motor and the associated cables and connectors. The test is separated into four parts.

Select the Motor Calibration/Test from the Functional Test menu. The four parts of the test are displayed.

1. **Initial Motor Speed Calibration (Volts)**
   The Main Board attempts to set the motor speed to 1600 RPM by applying 8 volts to the Motor Controller Board.
2. **Initial Motor Speed Reading (RPM)**
   The Main Board software verifies that the actual speed is within 20 percent of 1600 RPM.
3. **Adjusted Motor Speed Calibration (Volts)**
   The Main Board re-adjusts the motor speed by calculating the necessary scale factor based on the actual speed.
4. **Actual Motor Speed Reading (RPM)**
   The Main Board software verifies that the adjusted speed is within 3 percent of 1760 RPM.

Select the **OPEN MENU** key to start the test. The motor will shut off, restart itself, and continue through the tests. Verify the Status is **PASS**. The results are posted after each test. Results can be printed to the recorder by pressing the **PRINT STRIP** key.

4.4.6 Helium Tank Calibration

This test calibrates the helium pressure circuit.

Close the helium tank valve and remove the helium tank from the pump.

Press the **OPEN MENU** key to start the test. The helium offset is displayed. If the offset is too large, an "**Out of Specification**" message is displayed. If the offset is within the limits, a "**Within Specification**" message is displayed.

4.4.7 Pneumatic Performance Tests

1. Select Functional Tests from the Main Menu and then select Pneumatic Performance Test from the submenu.
2. Press the **ZERO PRESSURE** key to display pressure readings referenced to atmospheric pressure. Verify that the catheter input port of the Safety Disk is open to atmosphere.
3. Press the **OPEN MENU** key to start the test. The system begins to pump at 150 bpm for 30 seconds.
4. Once the system stops pumping, observe the vacuum recovery time display window. This period should be less than 10 seconds.
5. Verify that the average pressure reads between 300 and 413 mmHg. A lower reading may indicate a leak in the pneumatic system, a need to adjust the 8 PSI regulator, a flow restriction in the pressure line (clogged muffler), or the need to rebuild the pump motor. A higher reading indicates a problem with the 8 PSI regulator or the need to adjust it.
6. Verify that the average vacuum reads a minimum of -176 mmHg * (a lower number indicates more vacuum). A higher reading may indicate a leak in the pneumatic system or the need to rebuild the compressor.
7. Verify the minimum acceptable levels as shown in the following table:

PARAMETER	ACCEPTABLE LEVEL	REMARKS
First Inflate Delay (ms)	< 24 msec	Time from inflate command until the diaphragm begins to move.
First Deflate Delay (ms)	< 24 msec	Time from deflate command until the diaphragm begins to move.
Max. Vacuum (mmHg)	< -200 mmHg	Max. peak vacuum
Avg. Vacuum (mmHg)	< -176 mmHg *	Average vacuum
Max. Pressure (mmHg)	< 436 mmHg	Max. peak pressure
Avg. Pressure (mmHg)	300 to 413 mmHg	Average pressure
Inflate Transition (ms)	< 36 msec	Time to exceed 75% of peak pressure
Deflate Transition (ms)	< 36 msec	Time to exceed 75% of peak vacuum
Recovery Time (secs)	< 10 sec	Time to reach 150 mmHg (absolute)

* *-176 mmHg at sea level. See chart for acceptable average vacuum levels at higher elevations.*

Average Vacuum Levels

ALTITUDE (feet)	ATMOSPHERE (mmHg)	AVERAGE VACUUM (mmHg)
0	760	-176
1000	732	-163
2000	704	-148
3000	680	-137
4000	656	-125
5000	630	-111
6000	608	-101
7000	586	-90
8000	564	-80
9000	543	-69
10000	523	-60
11000	504	-51
12000	483	-40

8. Press the **BACK** key twice to return to the Main Menu.
9. Exit Service Diagnostics by switching the **ON/OFF** switch to OFF.

4.4.8 Blood Pressure Channel Checks

1. Power **ON** the unit into normal operating mode by switching the ON/OFF switch to ON. Select **SEMI-AUTO** mode.
2. Attach a blood pressure simulator or the System Trainer to the pressure input connector. Select **PRESSURE** trigger. Select **MANUAL FILL** mode by entering the Pump Option menu and selecting **MANUAL**.
3. Simulate a manual fill by pressing the **IAB FILL** key twice (hold for two seconds each time). Set the Trainer to vent (or simulator to "0" mmHg). Zero the pressure channel. Apply an 80 bpm pressure signal and verify the IABP triggers. Observe the flashing diamond, a Heart Rate reading, and **Pressure XX (e.g. 22) mm Auto Threshold** is indicated in the trigger source displayed in the upper right hand corner of the display. Initiate pumping by pressing the **START** key. The augmentation should increase automatically or increase the augmentation by pressing the **IAB AUGMENTATION UP ARROW** key. Verify that the LED bar graph illuminates in relation to the **UP** and **DOWN IAB AUGMENTATION** keys.
4. Select **PUMP OPTIONS**. Select pressure threshold and change it from Auto to Manual by using the **OPEN MENU** key. To change the threshold, use the **OPEN MENU UP** key. Verify that the trigger threshold increments and that the marker on the pressure display moves up. Press the **OPEN MENU DOWN** key and verify that the trigger threshold decrements and that the marker on the pressure display moves down. Press the **BACK** key, change the threshold from Manual to Auto. Verify that the Pressure Threshold returns to Auto. Close the **PUMP OPTIONS** menu.
5. Tap the **INFLATION INTERVAL** key and note that there is a momentary interruption in pumping. Press and hold the **INFLATION INTERVAL** key and observe that part of the pressure trace is highlighted and inflation interval markers are displayed. Observe that all pressure digits are displayed.
6. Set the **AUG. ALARM** limit to 10 mmHg below the current augmentation pressure. (At power up, the System automatically sets it after one minute of assist.)

7. If using a System 90 Series Trainer, decrease the augmentation level by pressing the **IAB AUGMENTATION DOWN** key. When the augmentation is below the alarm set point, verify that the double beep alarm and the "**AUGMENTATION BELOW LIMIT SET**" message is activated. If a Trainer is not available, increase the AUG. alarm limit to a value higher than the displayed AUG. value and verify that the double beep alarm and the "**AUGMENTATION BELOW LIMIT SET**" message is activated. Return the limit to 10 mmHg below the AUG. value.
8. Activate the **REFERENCE LINE**. Measure the pressure waveform using the reference line arrow keys. Digital display and reference line measurements should agree, ±3 mmHg.

4.4.9 ECG Channel Checks

1. Select **SEMI-AUTO** mode. Connect all 5 lead wires to the simulator (or connect the System Trainer) and apply an ECG signal. Enter the **ECG/AP Sources** menu and change the ECG leads. Verify the operation of the **ECG LEAD** key by observing the display while pressing the key and checking for the following lead changes: **I**, **II**, **III**, **AVR**, **AVL**, **AVF**, **V** and **EXTERNAL**. Verify that when EXTERNAL is displayed, the message "**NO CABLE**" appears.
2. Verify that there is a "**LEAD FAULT**" message displayed next to LEAD whenever the LA, RA, or LL leads are disconnected from the simulator/signal generator or the Trainer is unplugged.
3. Apply an ECG signal with R-wave less than 100 µV from the simulator/signal generator or with the System Trainer in sinus rhythm mode, select the AVL lead on the IABP. Verify that the System displays a "**NO TRIGGER**" message.
4. Verify that the ECG GAIN indicator is illuminated on the keypad and reflects NORMAL on the display.
5. Gradually increase the ECG GAIN by pressing the **ECG GAIN UP ARROW** key until the "**NO TRIGGER**" message disappears and a flashing diamond is visible on the display and check for a trigger rate. Return the ECG GAIN to the NORMAL position.
6. Apply a 1 mV ECG from the simulator/signal generator or select Normal Sinus Rhythm from the System Trainer and select Lead II. Select **INTERNAL** trigger. Verify that the System alarm tones and displays the "**ECG DETECTED**" message. Remove the ECG signal.
7. With **INTERNAL** trigger selected, verify that the System triggers at 80 bpm. Enter the **PUMP OPTIONS** menu and select **Internal Rate**. Press the **OPEN MENU** key and then vary the INTERNAL rate by using the **OPEN MENU UP** and **DOWN** keys. Verify that the internal rate varies from 40 bpm to 120 bpm. Return to 80 bpm and exit the **PUMP OPTIONS** menu.
8. Apply an ECG with A-V PACER. Verify that the System triggers in ECG TRIGGER mode. Switch the trigger mode to PACER V/A-V and verify that the System triggers and that the "**Pacer A/V**" trigger message is displayed.
9. Apply an ECG with V pacer. Verify that the System triggers in ECG TRIGGER mode. Switch the trigger mode to PACER V/A-V and verify that the System triggers and that the "**Pacer V"** trigger message is displayed.
10. Apply an ECG with an Atrial pacer. Verify that the System triggers in ECG TRIGGER mode. Switch the trigger mode to PACER A and verify that the System triggers and that the "**Pacer A**" trigger message is displayed.

11. Apply an ECG with A-V DEMAND pacer. Verify that the System triggers in ECG TRIGGER mode. Switch the trigger mode to PACER V/A-V and verify that the System does not trigger and that the "**CHECK PACER TIMING**" and/or "**NO TRIGGER**" messages are displayed.
12. Apply a 1 Volt, 60 bpm ECG signal to the input jack on the rear panel of the ECG monitor, positive (+) to the tip and negative (-) to the ring and sleeve. Verify that the ECG signal is displayed and that **External** is displayed next to LEAD. Verify that the System triggers in the ECG and PACER A trigger modes.

4.4.10 Preference and Printer Menu Checks

User Preferences Menu

Press the **USER PREFERENCES MENU** key to display the User Preferences Menu window. Select display preferences. Verify that the sweep speed and brightness level can be changed. Verify that Flash Alarms is on and that there is no external ECG signal. Enter the ECG/AP Sources menu and select **External ECG** input. Verify that the no trigger alarm flashes. Change flash alarm to off and verify that the alarm no longer flashes.

Select **Lead II** and turn on the ECG inflation markers. Verify that ECG inflation markers appear below the ECG waveform. Press **BACK** to return to the User Preferences Menu.

Select **Audio Preferences**. Verify that the beep volume can be changed. Press **BACK** to return to the User Preferences Menu.

Select **Printer Preferences**. Verify that ECG, Arterial Pressure and Balloon Pressure waveforms can all be printed. Verify that the recorder prints either single or dual waveforms and annotated information. Verify that the Trigger/Alarm logs can be printed. Press **BACK** to return to the Main Menu.

4.4.11 Pumping Checks

1. Attach a 6-foot catheter extender and 40 cc patient balloon to the Safety Disk.
2. Select **SEMI-AUTO** mode. Apply a 130 bpm ECG signal and select ECG trigger.
3. Set the INFLATION and DEFLATION controls to mid-position. Set the FILL and TIMING controls to **AUTO** or **Semi-Auto** and initiate an autofill.
4. Initiate pumping and let the System pump for a minimum of five minutes.
5. Initiate an autofill and verify that the autofill process is complete within 10 seconds and that no autofill failure occurs. An autofill failure may suggest a vacuum performance problem.
6. Apply a 100 bpm ECG signal and select ECG trigger.
7. Initiate pumping and select the IAB FREQUENCY of 1:2. Verify that the LED is illuminated and that every other beat is assisted. Verify that unassisted pressure values are displayed under the SYSTOLIC and DIASTOLIC screen measurements. Select 1:3 and verify that the LED is illuminated and that every third beat is assisted. Return the control to 1:1.
8. Vary the IAB AUGMENTATION keys from OFF to MAX and verify that when at OFF the balloon is totally deflated and the IAB STATUS indicator is at minimum. Verify that when set at MAX, the balloon completely inflates and that the IAB STATUS indicator deflects to the top. Verify that the LED bar graph illuminates in relation to the IAB AUGMENTATION keys.

9. While pumping, kink the catheter extender at the patient balloon end. Verify that the System stops pumping and that the "**CHECK IAB CATHETER**" message is displayed. Resume pumping by pressing the **START** key, let the System pump for a minimum of 10 beats and then disconnect the balloon from the catheter extender. Verify that the System stops pumping and that the "**IAB Disconnected**" message is displayed. Reconnect the extender and autofill the balloon to reset the alarm.

4.4.12 Portable Operation Check

1. If the calibration procedure has not been performed on battery power, check battery operation at this time.
2. While pumping, unplug the System from line power. Verify that pumping continues uninterrupted, that the "**BATTERY IN USE**" message is displayed and that the battery icon appears on the screen.
3. Reestablish AC power. Verify that uninterrupted pumping and that the BATTERY CHARGING indicator is illuminated.
4. Switch the AC MAINS switch on the rear panel to the OFF position and operate the System on battery for a maximum of 30 seconds. Switch the AC MAINS switch back to the ON position and observe the BATTERY CHARGING indicator. Verify the proper sequence of the indicator as follows: After first turning the switch ON, the LED should be flashing on-off, followed by a constant illuminated state. This LED sequence indicates that the charger is functioning properly.

4.4.13 Manual Fill Valve

Attach a 60 cc syringe to the rear panel MANUAL FILL valve. Push the syringe into the valve and verify that it fills with helium. Ensure that the valve seals after the syringe is removed.

4.4.14 Timer Check

Verify that time has elapsed on the hour meter since the beginning of the procedure. If necessary, record these hours on preventive maintenance records.

4.4.15 Helium Checks

1. Ensure that the helium gauge reads above 215 PSI when the tank is open and that the "**Low Helium**" alarm message is not activated.
2. Close the helium tank valve and note the gauge reading. Leave the valve closed for 5 minutes and then read the gauge again. The gauge reading should not drop. A drop in gauge pressure indicates a leak in the helium supply circuit.
3. Leave the tank valve closed and bleed off the helium supply by activating the MANUAL FILL valve, or by repeatedly autofilling. Verify that the "**Low Helium**" alarm message is displayed before the helium gauge reaches 0 PSI.

4.4.16 Fan Check

1. Verify that the rear panel cooling fan is exhausting and that the fan grill is unobstructed and clean. Vacuum if necessary.
2. Verify that the Condensate Removal Module cooling fan is functional and that the fan opening is unobstructed and clean. Vacuum if necessary.

4.5 Leakage Current Test - Safety Checks

4.5.1 Source Current, Chassis Case to Ground Leakage

1. Plug the System into the safety analyzer, as shown in FIGURE 4-13. Connect the CASE ground lead of the analyzer to the GND lug.

2. With the unit fully "**ON**", perform the test under the following conditions:

A. Case Grounded:

1. Polarity Normal

2. Polarity Normal with Open Neutral

B. Case Ungrounded:

1. Polarity Normal

2. Polarity Normal with Open Neutral

3. Reverse Polarity

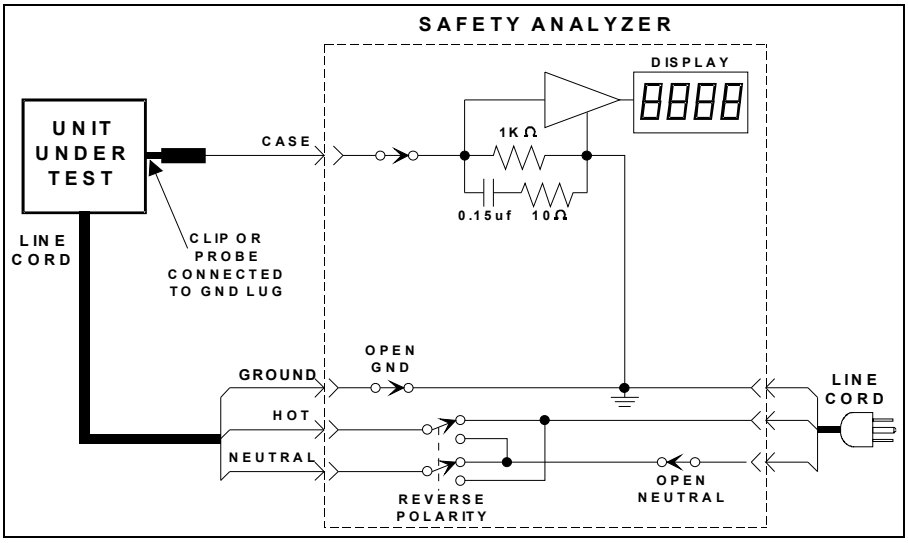


FIGURE 4-13

C. Using the table below, verify that the current reading for the input voltage is less than that which is indicated for the specified test.

Maximum Leakage Current

INPUT VOLTAGE	CASE GROUNDED	CASE UNGROUNDED
100 - 120V	100 µA	100 µA
220 - 240V	100 µA	500 µA

4.5.2 Lead to Ground

Sink Current Patient Circuit

1. Connect the PATIENT CABLE from the safety analyzer to the **CS300**, as shown in FIGURE 4-14.
2. Press the **APPLY 115VAC** button and note the reading.
3. Repeat the test for normal, open ground, and reverse polarity combinations.Verify that the current reading for any test is less than 20 μA for 100 - 120V input voltage and less than 50 μA for 220 - 240V input voltage.

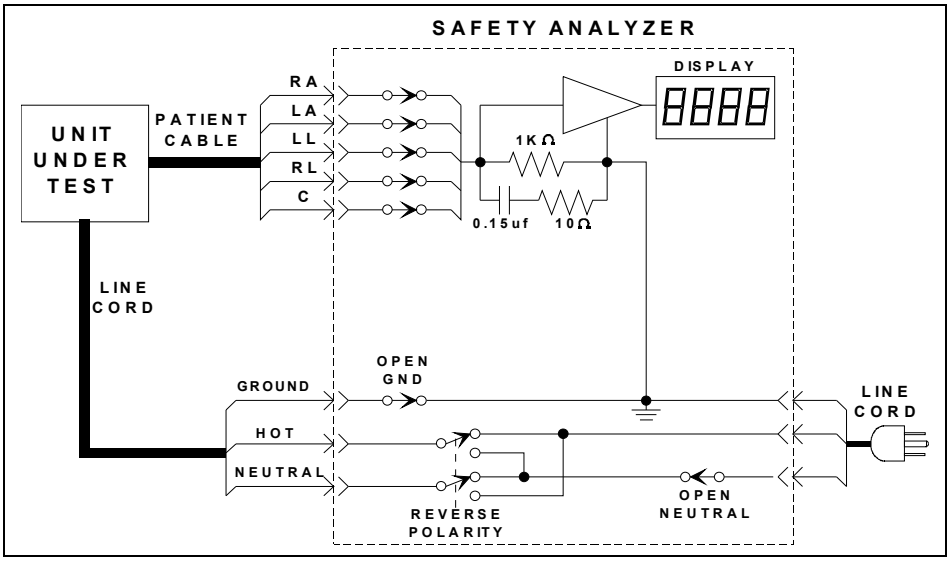


FIGURE 4-14

4.5.3 Ground Resistance

This test measures the resistance from the case (ground lug) to the U-blade on the AC line cord. (Consult the specific test instructions for your model of safety analyzer)

1. Plug the **CS300** into the safety analyzer. Attach the resistance measuring probe on the analyzer to the **CS300** ground lug on the rear panel.
2. Invoke the resistance function as noted in the specific test instructions for your model of safety analyzer.
3. Verify that the resistance to ground is less than 0.1 Ω.

4.5.4 Calibration Test Point Locations

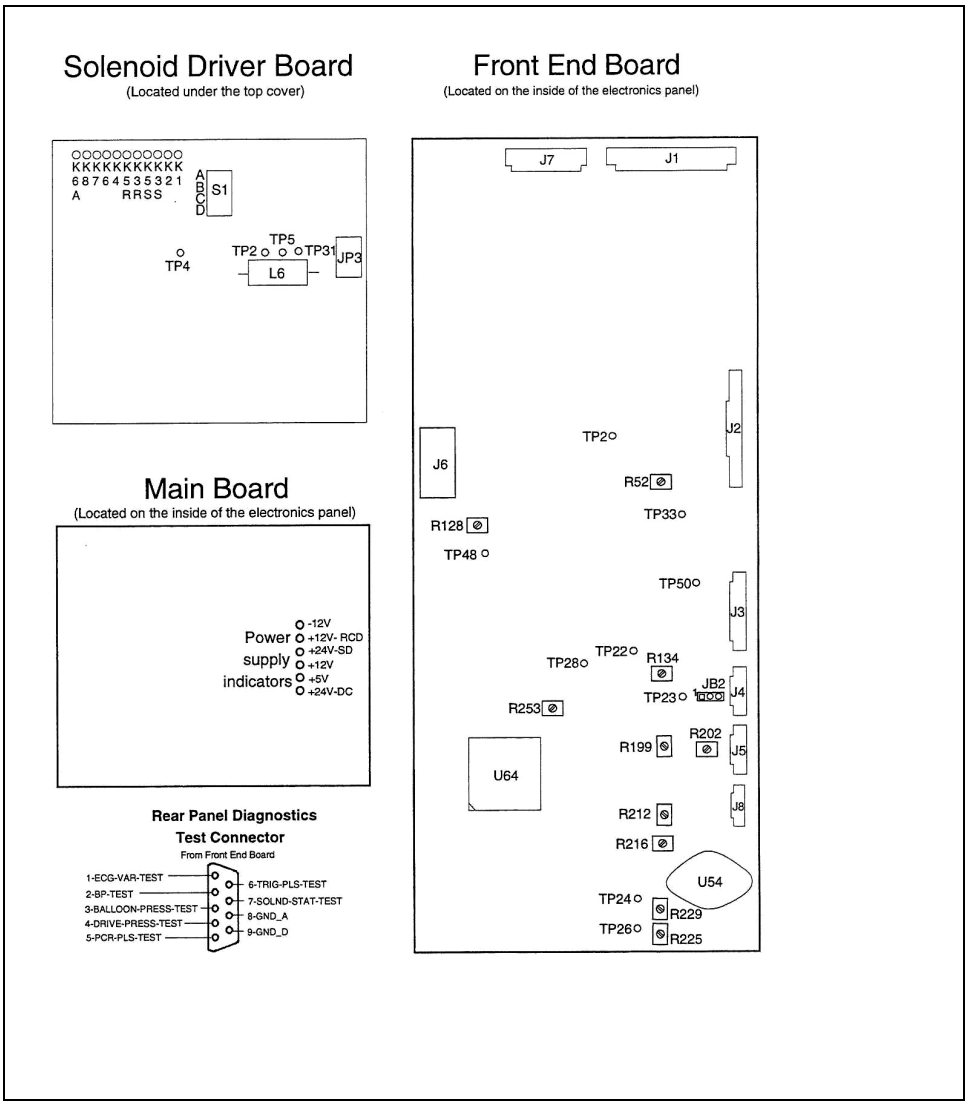


FIGURE 4-15 Calibration Test Point Locations

NOTE: **Only the test points needed for calibration are shown, complete board layouts are shown, See "Theory of Operation" on page 1-1. Individual board drawings are for reference only and are not drawn to scale.**

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5.0 *Preventive Maintenance*

5.1 Introduction

This section provides guidelines and instructions for performing preventive maintenance on the **CS300**. The clinical user and the biomedical equipment technician (BMET) are provided with the necessary information to enhance the reliability of the equipment.

5.2 Required Parts

2500 Hour Maintenance Kit (P/N 0040-00-0146)

This kit is installed at 2,500, 7,500, 12,500 etc. hours and includes the following items:

QTY	DESCRIPTION	PART NUMBER
2	Pump Diaphragms	0348-00-0129
1	Muffler	0103-00-0065
1	Filter Element	0103-00-0370
4	Hose Clamps	0125-01-0001
1	Filter Gasket	0354-00-0042-01
1	Filter Gasket	0354-00-0042-02
1	Tubing Assembly, Filter	0008-00-0331

5000 Hour Maintenance Kit (P/N 0040-00-0147)

This kit is installed at 5,000, 10,000, 15,000 etc. hours and includes the following items:

QTY	DESCRIPTION	PART NUMBER
1	Pressure Head	0997-00-0402
1	Vacuum Head	0997-00-0401
2	Pump Diaphragms	0348-00-0129
1	Filter Element	0103-00-0370
1	Muffler	0103-00-0065
4	Hose Clamps	0125-01-0001
1	Filter Gasket	0354-00-0042-01
1	Filter Gasket	0354-00-0042-02
1	Tubing Assembly, Filter	0008-00-0331

Special Items:

- 0 - 30 inch pound torque limiting screwdriver (with 4 mm hex bit)
- Loctite #242 thread locker

5.3 System Log Book

A valuable tool for implementing a preventive maintenance program is the establishment of a log book in which relevant information is recorded on a regular basis. This allows for verification of necessary maintenance and for evaluating equipment reliability.

The following is recommended as the contents of the log book:

1. A listing of the Safety Disk and System serial numbers.
2. Dates on which preventive maintenance is performed and by whom.
3. Intervals of consumable and maintenance parts replacements; a reading from the System timer should also be recorded.
4. Phone numbers for local Service Representatives and for the Datascope Service Department.
5. Results from safety testing, including chassis and patient leakage currents.
6. Performance related measurements, including pressure and vacuum levels and any discrepancies found during calibration and functional tests.

5.4 Preventive Maintenance Schedules

Two preventive maintenance schedules have been provided.

Schedule A indicates which actions should be taken by either the Clinical User or by a Biomedical Technician (BMET). These steps do not require the use of tools and may be performed in a clinical setting.

Schedule B indicates the actions which should be performed only by a BMET or other qualified service personnel. Tools are required and, in some cases, the instrument covers must be removed.

WARNING: Preventive Maintenance should not be performed when the IABP is attached to a patient.

Schedule A

To be performed by the clinical user or the BMET.

		INTERVAL			
	REQUIRED ACTION	**BEFORE OR AFTER EACH USE**	**EVERY MONTH**	**EVERY 6 MONTHS**	**EVERY 1000 HRS. OF USE OR 2 YRS.***
1.	Clean system if necessary. Check cables, Auto Fill tubing, safety disk Luer fittings, and line cord.**	●			
2.	Perform Safety Disk Leak Test (See "Safety Disk Leak Test" in the **CS300** Operator's manual.)	●			
3.	Check Auto Fill operation and helium supply.		●		
4.	Check lead fault, transducer operation, low helium.		●		
5.	Check battery system (See "Batteries" in the **CS300** Operator's manual.) Check Battery Indicator (See "Front Panel" in the **CS300** Operator's manual.)	●			

* *Whichever comes first.*

** *Patient contact parts, such as ECG leads and blood pressure transducers, should be kept clean and disinfected. Standard hospital operating procedures regarding cleaning and infection control should always be observed.*

		INTERVAL			
	REQUIRED ACTION	**BEFORE OR AFTER EACH USE**	**EVERY MONTH**	**EVERY 6 MONTHS**	**EVERY 1000 HRS. OF USE OR 2 YRS.***
6.	Replace Safety Disk (See "Safety Disk/Condensate Removal Module" in the **CS300** Operator's manual.)				●
7.	Check battery run time. Replace batteries when operating time is marginal. (See "User Maintenance Between Pumping Procedures" in the **CS300** Operator's manual. See "Batteries" in the **CS300** Operator's manual.)			●	

* *Whichever comes first.*

** *Patient contact parts, such as ECG leads and blood pressure transducers, should be kept clean and disinfected. Standard hospital operating procedures regarding cleaning and infection control should always be observed.*

WARNING: Preventive Maintenance should not be performed when the IABP is attached to a patient.

Schedule B

To be performed by the BMET.

		INTERVAL		
	REQUIRED ACTION (REFER TO SERVICE MANUAL)	**EVERY 6 MONTHS**	**EVERY 2500 HOURS**	**EVERY 5000 HOURS**
1.	Perform visual inspection check list.	●		
2.	Calibrate system and perform functional test.	●		
3.	Check battery for rated voltage and check battery run time. Replace batteries when operating time is marginal or after three (3) years.*	●		
4.	Replace the muffler, the pneumatic filter and diaphragms located on the pump assembly. Confirm operation of the power supply and compressor housing fans.		●	
5.	Clean the pump compartment. Inspect hoses and pump shock mounts.		●	
6.	Replace the vacuum and pressure heads on the pump.			●

* *This does not imply a three year warranty.*

REQUIRED ACTION (REFER TO SERVICE MANUAL)		INTERVAL		
		EVERY 6 MONTHS	EVERY 2500 HOURS	EVERY 5000 HOURS
7.	Replace the pneumatic filter located on the purge line.		●	
8.	Vacuum inside of front cover and power supply intake.	●		
9.	Perform Fiber Optic Test. Clean Fiber Optic components and retest.		●	

* *This does not imply a three year warranty.*

5.5 Visual Inspection Checklists

5.5.1 Weekly or Before Each Use

To be performed by the clinical user or the BMET.

- **Unit Appearance:** Inspect the unit for physical damage. Check the operation of the docking mechanism on the monitor module. Check the battery latch and the locking function of the casters on the hospital cart.
- **Cords and Cables:** Inspect line cord, patient cable, external interface cables, and transducer cables for frayed wires, loose connections, or any physical damage.
- **Controls and Switches:** Check all controls and switches and ensure that they are tight and mechanically sound.
- **Safety Disk:** Inspect the fill tubing and Safety Disk for damage. Check fittings for tightness. Check the operation of the fan on the condensate removal module.
- **Cooling Fan:** Check the rear panel fan for operation and clean the rear panel grill if necessary.
- **Doppler:** Check the operation of the Doppler and the Doppler retractor mechanism.

5.5.2 Every 6 Months or 2500 Hours of Use

To be performed by the BMET or other qualified service personnel.

- **Pneumatic Compartment:** Inspect all pneumatic fittings and tubing for cracks and for tightness in the entire pneumatic compartment. Inspect cables and connectors for frayed wires, loose connections, or any physical damage.
- **Fill/Purge Assemblies:** Inspect the associated tubing for kinking or cracks. Inspect cables and connectors for frayed wires, loose connections, or any physical damage. Ensure that the Fill purge tubing is clear and that the drain tubing is routed through the blood sensor. If water condensation is found in the tubing, perform the Water Condensation Removal Procedure listed in this subsection.
- **Motor Compartment:** Inspect the motor compartment for dust and debris and vacuum as necessary. Replace the muffler if excessive dust is observed. Inspect the pump tubing and fittings for tightness and cracks. Inspect the shock mounts for cracking or excessive wear and replace if necessary. Check fan operation.
- **Electronics Panel:** Inspect the connectors and cables on the electronics panel (Main and Front End PCBs) for frayed wires, loose connections, or any physical damage. Check operation of the handle and inspect the slide latch and guide stop for cracks or wear.
- **Water Condensation Removal Procedure:** The following procedure can be performed to remove water and should be performed during Preventive Maintenance to minimize water related operation difficulties.
  - **a.** Enter Service Diagnostics and Select Pneumatic System Test.
  - **b.** Disconnect anything that may be attached to the IAB Catheter Extender Input port on the Safety Disk. Activate K3 and K5 to purge the entire Drain Line. Select Safe State.
  - **c.** Plug the IAB Catheter Extender Input on the Safety Disk and activate K1, K2, K3, K4, and K5.
  - **d.** Move the cursor up to K2 and deactivate it to refill the cylinder. Activate K2 to empty the cylinder again. This will fill and then empty the Volume Cylinder. This process will clear the path from the cylinder to the Vacuum Reservoir. Complete several more cycles of K2 on/off.
  - **e.** Select Safe State.

- **Power Supply:** Vacuum the power supply intake of dust and debris. Vacuum the inside of the Front Panel
- **Fiber Optic Assembly:** Perform Fiber Optic Test. Clean the Fiber Optic components and retest.

5.6 Access and Replacement Instructions

5.6.1 Pump Maintenance Instructions

Replacement Diaphragms	P/N 0348-00-0129
Replacement Pressure Head	P/N 0997-00-0402
Replacement Vacuum Head	P/N 0997-00-0401

The pressure/vacuum pump is fitted with neoprene diaphragms which should be replaced at 2500 hour intervals to enhance System reliability.

1. (See FIGURE 5-1) Remove the System from the hospital cart. Remove the right side cover and the left lower cover from the System. Remove the two nuts at the rear of the pump compartment and remove the pressure and vacuum lines through the access hole provided. Remove the two screws at the base of the pump assembly and slide the pump housing out. Remove the 14 screws that retain the cover and remove the cover.

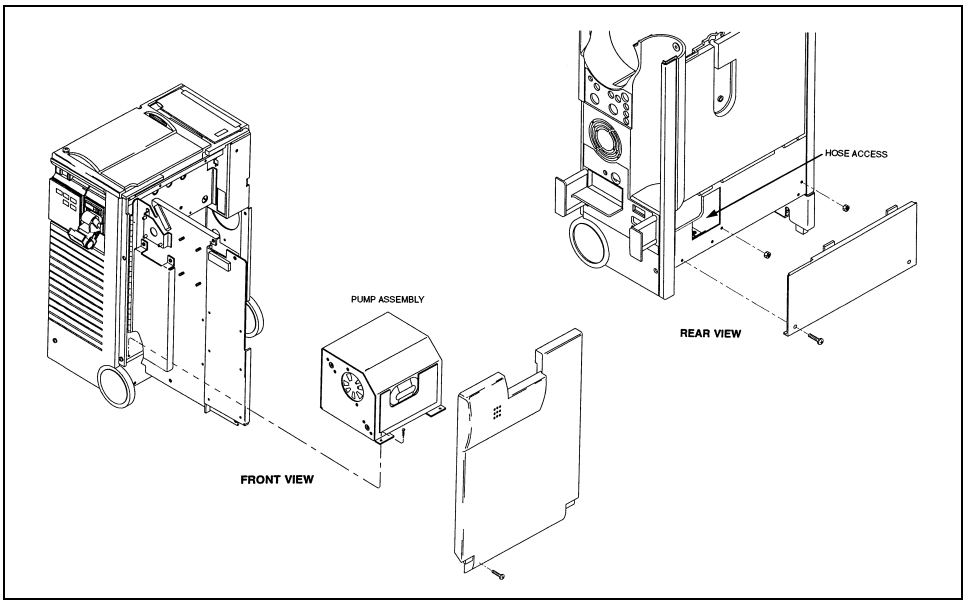

FIGURE 5-1 Pump Assembly Removal

2. Refer to FIGURE 5-2. Cut off the hose clamps from the vacuum and pressure heads on the pump assembly. Remove the hoses from the heads.

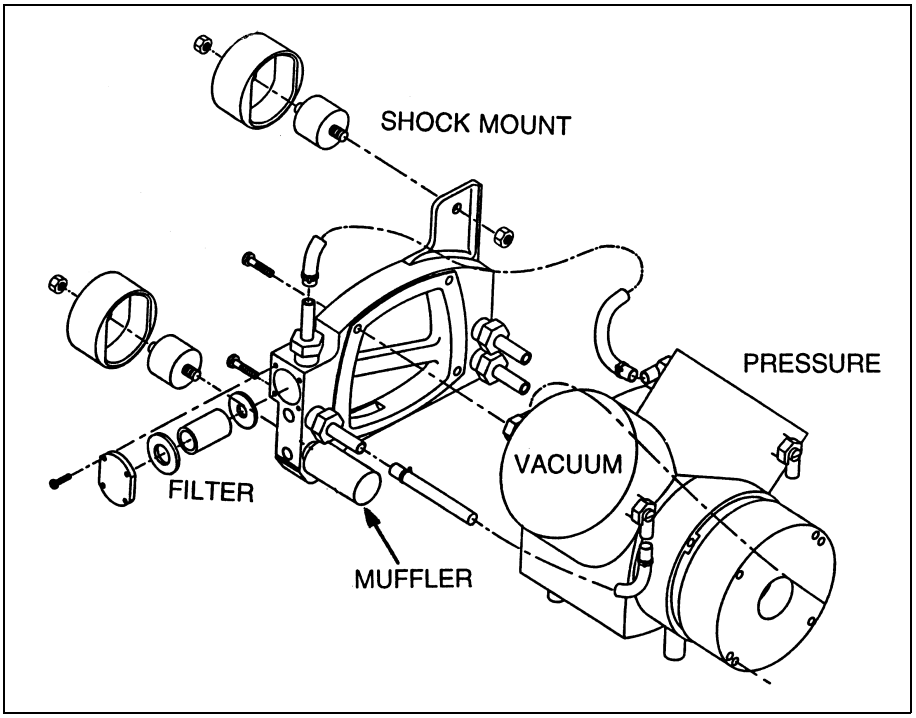

FIGURE 5-2 Pump Assembly, Exploded Isometric View

3. Using a 4 mm hex wrench, loosen and remove the four pump head bolts on both heads. Remove both pump heads.

NOTE: **If maintenance is being performed at the 5000 hour interval, the pump heads are discarded and replaced with new ones.**

4. Loosen and remove the diaphragm retaining screw (See FIGURE 5-3).

5. Remove and discard the diaphragm.

6. Install the replacement diaphragms in the following manner: Pressure side = smooth surface facing out, Vacuum side = rough surface facing out. Apply 1 or 2 drops of #242 Loctite to the diaphragm retaining screw and tighten securely. Ensure that the diaphragm lies flat across the compressor housing.

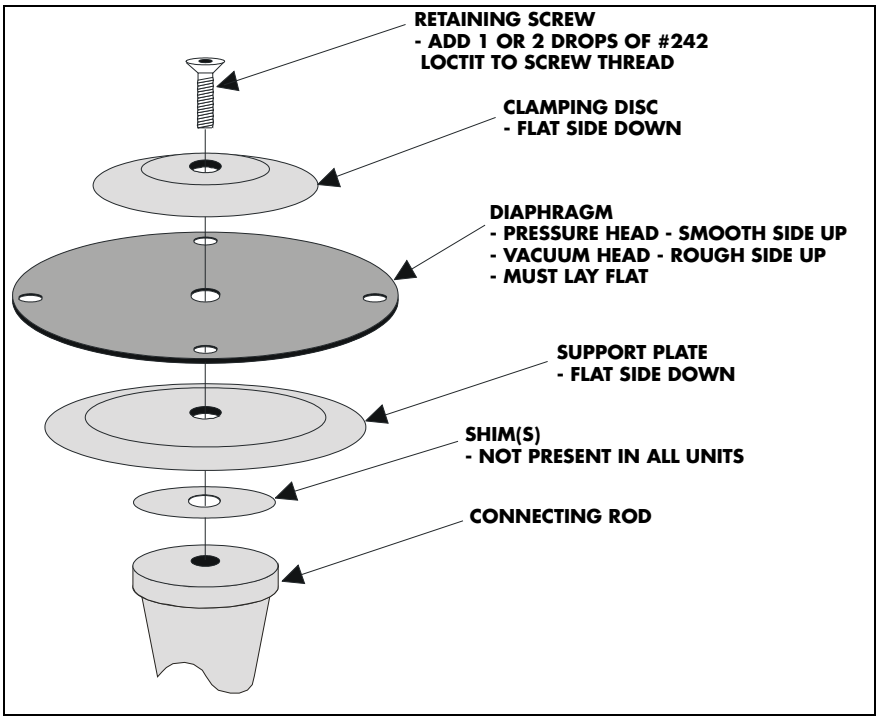

FIGURE 5-3 Diaphragm Reference

7. Reinstall the pump heads (install new heads if at the 5000 hour interval) and tighten the four head screws to 25 inch pounds using the cross pattern as shown in FIGURE 5-4.
8. Reinstall the tubing to the pump heads using new hose clamps.

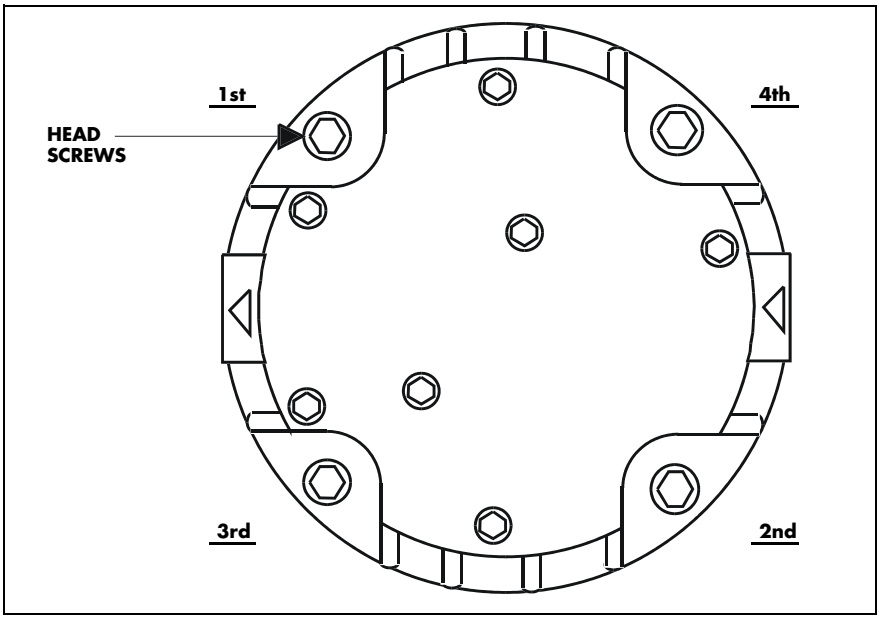

FIGURE 5-4 Screw Cross Pattern

5.6.2 Pump Muffler Replacement

Replacement Muffler P/N 0103-00-0065

1. Remove the System from the hospital cart (See FIGURE 5-1). Remove the right side cover and the left lower cover from the System. Remove the two nuts at the rear of the pump compartment and remove the pressure and vacuum lines through the access hole provided. Remove the two screws at the base of the pump assembly and slide the pump housing out. Remove the 14 screws that retain the cover and remove the cover.
2. Remove the muffler by rotating it counterclockwise (See FIGURE 5-2).
3. Replace the muffler, do not over-tighten. There is no need to apply sealant to the pipe fittings.

5.6.3 Pneumatic Filter Replacement Instructions

The pneumatic filter is a porous element that will capture particles larger than 40 microns if they should enter the pressure drive system. Regular replacement of the filter element will prevent eventual restriction in airflow.

Replacement Filter	P/N 0103-00-0370
Washer	P/N 0354-00-0042-01
Washer	P/N 0354-00-0042-02

1. Remove the System from the hospital cart (See FIGURE 5-1). Remove the right side cover and the left lower cover from the System. Remove the two nuts at the rear of the pump compartment and remove the pressure and vacuum lines through the access hole provided. Remove the two screws at the base of the pump assembly and slide the pump housing out. Remove the 14 screws that retain the cover and remove the cover.
2. Remove the four screws that retain the filter access cover (See FIGURE 5-2).
3. Remove the filter element and discard.
4. Clean all parts with a soft, damp cloth as necessary.
5. Replace the filter element and washers, reinstall the cover.

5.6.4 Shock Mounts and Hoses

Replacement Shock	P/N 0348-00-0169-01
Pressure Tubing	P/N 0004-00-0051
Vacuum Tubing	P/N 0004-00-0050
Cable Tie	P/N 0125-01-0001

1. Remove the System from the hospital cart (See FIGURE 5-1). Remove the right side cover and the left lower cover from the System. Remove the two nuts at the rear of the pump compartment and remove the pressure and vacuum lines through the access hole provided. Remove the two screws at the base of the pump assembly and slide the pump housing out. Remove the 14 screws that retain the cover and remove the cover.
2. Vacuum accumulated dust from inside the pump compartment.
3. Inspect the four shock mounts for signs of cracking or excessive wear. Replace as necessary (See FIGURE 5-2).
4. Inspect the vacuum and pressure tubing for tightness. Check for cracking or excessive wear.

5.6.5 Battery Replacement

Although the rechargeable batteries used in the **CS300** can be charged and discharged many times, they are gradually consumed during the normal course of operation. The battery should be replaced every 3 years or sooner if the battery operating time is marginal. Battery replacement should be performed by a BMET or other qualified service personnel. Batteries must be replaced in sets.

Replacement Battery Pack Assembly P/N 0146-00-0047-01 or P/N 0146-00-0051*

Replacement batteries** P/N 0146-00-0039

1. Put the IABP ON/OFF switch in the OFF position. Unplug the line cord from the AC outlet and ensure that the BATTERY CHARGING indicator is not lit.
2. Lift the battery release latches. Lift the unit off of the battery assembly and set it aside.
3. (See FIGURE 5-5) Remove the top cover. Remove the jumper and the cable assembly from the battery terminals, being careful not to contact adjacent terminals.
4. Remove the batteries from the tray. Remove and reuse the terminal clips to reconnect the jumper and cable assembly to the new batteries. Be sure to connect the red wire to the + terminal and the black wire to the - terminal.
5. Reinstall the top cover, ensuring that the cables are routed into its raised area.
6. Reconnect/install the battery assembly into the **CS300**.
7. Plug in the line cord, ensure that the AC MAINS switch is ON and verify that the BATTERY CHARGING indicator is lit.

This battery assembly is used when the* ***CS300* *is ordered with a docking station. Refer to FIGURE 5-5 for an illustration of this battery assembly.*

***Both battery cells must be replaced together.*

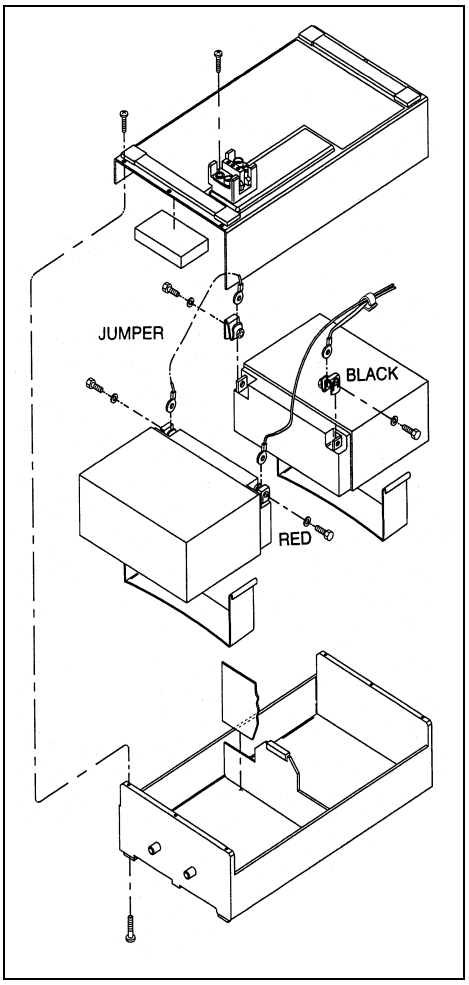

FIGURE 5-5 Battery Assembly, Exploded Isometric View

8. Switch the **CS300** on, select **SEMI-AUTO** mode and select INTERNAL trigger. Wait a minimum of 1 minute and then unplug the System. Verify that the System operates from battery and that the "**BATTERY IN USE**" message is displayed. Reestablish AC power and verify that the BATTERY CHARGING indicator is illuminated.
9. In order to establish a full battery charge prior to returning the System to service, leave it plugged in and charging overnight (18 hours), or 8 hours to achieve at least 90 percent charge (typically).

5.6.6 Purge Line Filter Replacement

The purge line filter is a porous element which will capture particles larger than 43 microns if they should enter the purge line. Regular replacement of the filter will prevent eventual restriction in airflow.

Replacement Filter P/N 0008-00-0331

1. Remove the top cover. Remove the existing filter and silicon tubing from the purge line barb fittings (located near the Purge assembly), and discard the filter (See FIGURE 5-6).

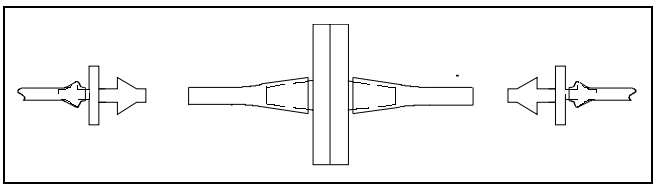

FIGURE 5-6 Filter Removal

2. The new filter is shipped with a pair of barb fittings in place. Remove these fittings and discard them. The assembly should then look resemble FIGURE 5-7.

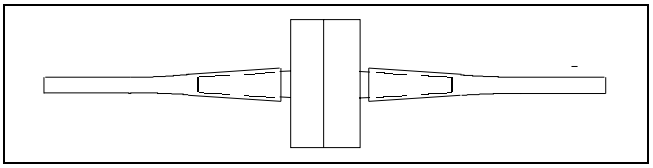

FIGURE 5-7 Replacement Filter

3. The filter must be installed in the correct orientation (See FIGURE 5-8). Install the filter and silicon tubing onto the existing barb fittings. The completed installation should appear as in FIGURE 5-9.

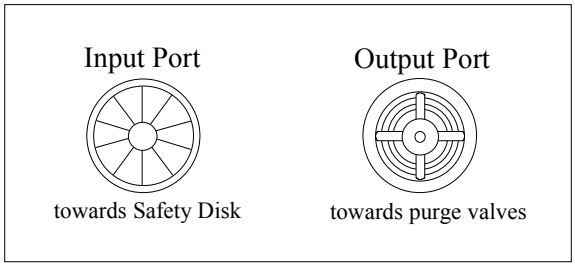

FIGURE 5-8 Filter Orientation Reference

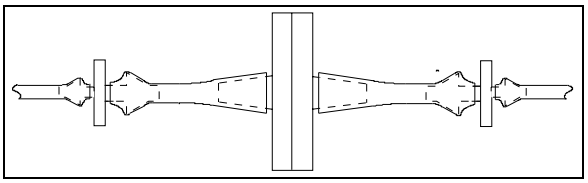

FIGURE 5-9 Completed Filter Installation

4. Perform Safety Disk leak and Autofill Tests using Service Diagnostics. The addition of the filter shall not degrade the performance of these tests. Reinstall the top cover.

5.6.7 Power Supply

Cleaning the input of the Power Supply of dust and debris will prevent eventual restriction of airflow. Vacuum the input and the inside of the Front Panel, and the input of the Power Supply. If necessary, use a can of compressed air and spray into the intake of the Power Supply.

5.6.8 Clean Fiber Optic Assembly

Fiber Optic Cleaning Kit (P/N KIT-CLEANING) includes:

- Fiber Optic Cleaning Wipes (50/pkg) (P/N 0683-00-0522-02)
- Fiber Optic Cleaning Swabs (5/pkg) (P/N 0683-00-0519-02)
- Fiber Optic Cleaning Solution (P/N 0683-00-0521-01)

The Fiber Optic Sensor and Ferrules must be clean in order to provide accurate readings from the Sensor IAB.

Perform the Fiber Optic Test in Service Diagnostics and print the results.

Lamp Ferrule

1. Pick up and hold a folded wipe between the thumb and forefinger. Wrap the folded wipe around the sides of the Ferrule. Rotate the pad around the Ferrule several times.
2. Unfold another cleaning wipe so that it is only 2-ply thickness exposing the clean side. Place on a hard, flat surface.
3. Wipe the face of the Ferrule over the pad in a one-way direction. Perform this 10 times but not over the same place on the pad. Use the length of the wipe from the fold.

NOTE: Do not touch the ferrule after cleaning.

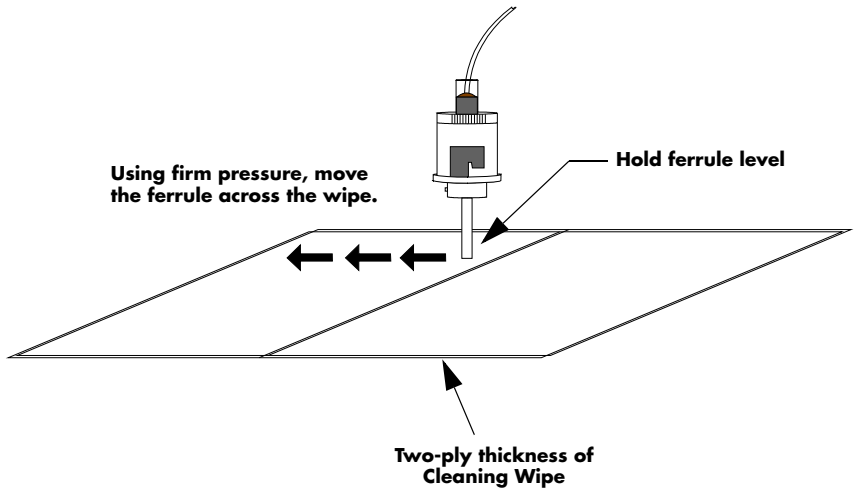

FIGURE 5-10 Cleaning the Lamp Ferrule

Sensor IAB Optical Receptacle

1. Use a short blast of compressed air to loosen and remove dirt from the connector.

NOTE: **Do not turn the can of air upside down to clean the Optical Receptacle. Always spray a short blast of air to remove dust particles within the tube before spraying into Optical Receptacle.**

2. Using the can of Fiber Connector Cleaner, position it on its side as shown and fill the well with cleaning fluid by gently pushing on the spray nozzle.
3. Carefully insert the swab into the well of the can of cleaner so that the swab can wick the cleaning fluid.
4. Gently insert the swab into the Optical Receptacle and rotate the swab in a clockwise direction, 8 to 10 times. Pull the swab straight out.

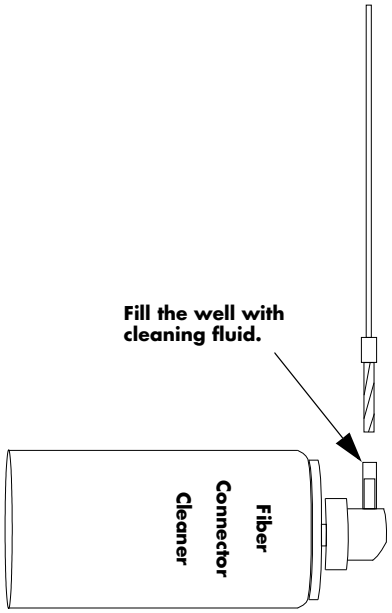

FIGURE 5-11 Cleaning the Sensor IAB Optical Receptacle

Perform the Fiber Optic Test and verify the results against the original print-out.

5.6.9 Fiber Optic Lamp Replacement

NOTE: There are two lamps in the Fiber Optic Lamp Assembly. The replacement kit (0040-00-0437) contains two lamps and Datascope recommends replacing both at the same time.

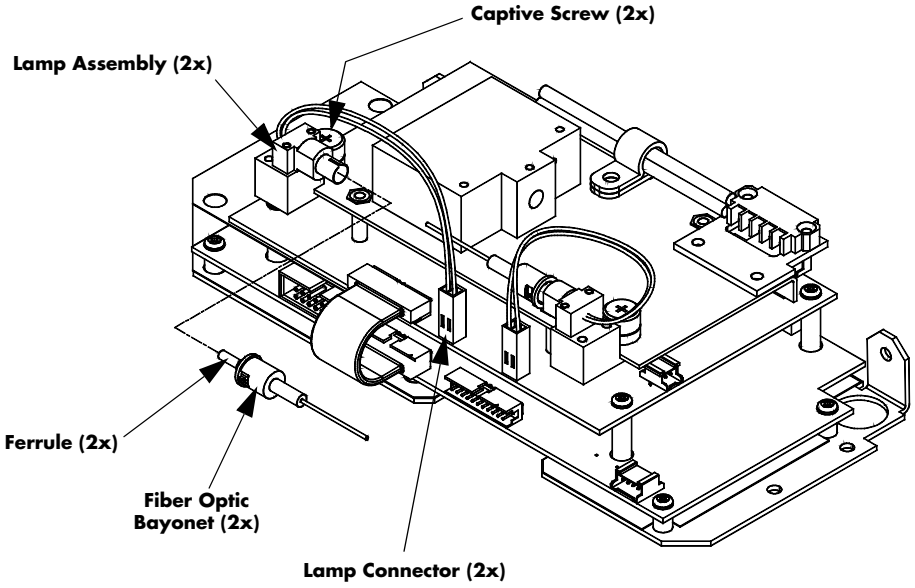

FIGURE 5-12 Fiber Optic Lamp Assembly

1. Remove the Top Cover from the CS300 Console.
2. Disconnect the 2-pin connector of the lamp from the PCB.
3. Carefully disconnect the Fiber Optic Bayonet connector by applying a slight inward pressure and rotating the connector counterclockwise.
4. Carefully pull back the Fiber Optic Bayonet and expose the Ferrule. Be sure not to touch or scratch the end of the Ferrule. Place the Ferrule/Fiber Optic Bayonet on top of the adjacent fiber bundle, away from the lamp or in a safe location.
5. Loosen the captive screw to remove the lamp assembly.
6. Remove the two screws that secure the lamp to the mounting block. Note the lamp orientation. Retain the screws and mounting block for reassembly.
7. Secure the new lamp onto the mounting block using the two screws.
8. Install the lamp assembly onto the PCB and tighten the captive screw.
9. Clean the end of the Ferrule by following the cleaning instructions in section 5.6.8.
10. Place the Ferrule into the lamp by applying a slight pressure and rotate the connector clockwise.
11. Repeat steps 2 through 10 for the other lamp.
12. Clean the Sensor IAB Optical Receptacle by following the cleaning instructions in section 5.6.8.
13. Enter Service Diagnostics and test the lamp output (Functional Test/Fiber Optic Test).
14. Reattach the Top Cover.

To reorder the CS300 Service Manual, use part number 0070-00-0689.

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